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Marine Engineering News,

LONDON, APRIL 1, 1879.

A RETROSPECT AND A LOOK OUT.

THE length of time which has elapsed since we last had the pleasure of addressing our readers has been marked by events of an important character. Amongst the foremost we have to chronicle is the death of one who was indeed a prince and leader among us, JOHN PENN, Marine Engineer. So long as there is Marine Engineering, his name will be held in kindly remembrance, for it is stamped in letters of gold on its history, which indeed cannot be written without giving due prominence to one of its most noble and important figures. Of Mr. Penn we need say little. Such of our readers as did not know him personally, knew him almost as well through some of the best of their acquaintances, who would testify of him that as an engineer he was highly skilled, and none more so—"he could'nt afford to turn out second-rate work"—and that as a man and a master he was well beloved, and no one better. In fact as the old gate-keeper told Mr. Smiles, when talking of Mr. and Mrs. Penn, "There was nobody like them."

The sad disaster which happened to the "Princess Alice" steamer removed from us our esteemed friend and valued contributor, James Hosken, C.E., son of Admiral, formerly Captain, Hosken, R.N., whose name is so well known in connection with the earlier history of Steam Navigation. Mr. James Hosken was lost, with his wife and two children. A pupil of the late Mr. Penn's, he went afterwards to sea in the Royal Charter, and some boats of Royal West India Mail. S.P. & Co. was for some time with Messrs. Napier at Glasgow, with Mr. Anderson at Woolwich Arsenal, and ultimately established himself as Consulting Engineer, and Steam Ship Surveyor in London. He was thoroughly practical and pre-eminently a "Marine Engineer," and a truthful, sincere, and honest man. We shall long feel his loss.

That sad ship the Thunderer, fated, perhaps to be more destructive to its occupants than it will ever be to the enemy, has been the scene of another explosion—this time the rupture of its 38 ton gun, causing general surprise and consternation. The evidence at the committee showed most clearly "there had been a failure of the electric firing apparatus, a failure of the hydraulic apparatus; that the men had failed to discover the failure of the washing arrangements, and the ramming arrangements." Everywhere in fact there was a failure. The vessel indeed has failed to be anything but a huge box of intricate mechanism with dangerous surprises for all in her. The careful inquiry suggested by the Duke of Somerset to be made by naval and scientific men (by "scientific" men, the noble lord meaning "men who were accustomed to ability,") will not to our mind be satisfactorily carried on unless to the number of such men are added "practical" men, I.E. "engineers" who understand thoroughly mechanical principles and the "correct application of nature's laws."

It is a most serious question whether we are not prepetuating a series of blunder by the building of huge iron clads. This is the view that Mr. Brassey takes of the matter, judging from his lengthy and sensible letter to the "Times" on the Italian iron clads wherein he warmly opposes extreme dimensions, and would appear to advocate small easily handled vessels of half the armament to the huge inert cells of mines and concealed dangers that have lately been so much insisted upon as the right thing. Our Yankee cousins are wise enough to let us experiment for them, and whilst we are spending huge sums to determine which is the more irresistible, shot or armour, and building numbers of costly ironclads, are familiarising themselves thoroughly with the construction and use of submarine torpedoes, and making themselves comparatively impregnable against the attacks of scores of iron clads at less than the cost of two or three of these unwieldly monsters.

Another struggle, that between steel and iron, is becoming an active one. Bridges have been built of steel, steel rails have displaced iron ones, and steel armour for vessels and forts is made; but what concerns us more intimately, is, that it is evident ere long steel will extensively displace iron as a material with which to build ships, and doubtless the next few months will witness a great increase in the number of vessels built of this metal, and also its extensive use in the construction of boilers. Some reports as to the extraordinary resistance afforded by the steel of which several vessels were built in Sweden, when they met with disasters, have been published, and will on a future occasion be further alluded to in this journal.

The question of the construction of river passenger boats in such manner, that the safety of all the passengers shall be insured under such circumstances for example as the running down of the Princess Alice, or the providing of such steamers with appliances that will ensure the same much to be desired object, is one which has been and is still occupying the minds of both practical men and humanitarian enthusiasts. Amongst others, the plans of Mr. Richard Roper of Lewisham and a Mr. Dougan are receiving some share of attention, and we purpose to notice them in an early issue. The prevention of all collisions with their attendant horrors much needs consideration, and a strict adherence to the Rules of the Road at Sea, should be insisted upon and a departure from them, severely punished. The increase of the number of night collisions, is alarming, and can, in the majority of instances, be clearly traced to defective lights, ignorance of, or apathy and neglect of Article 16, in the Steering and Sailing Rules.

There are good times coming though, for doubtless many Inventors are cudgelling their brains to find a salve for these and all other evils, and are not inventors to have all their heavy burdens taken off by the generous action of the Attorney General in his, "Bill to Consolidate with Amendments the Acts relating to Letters Patent for Invention?" Are not Messrs. Anderson, Mundella, Dalrymple, and Brown also in the field to improve the Inventor's position? Well, there is much that is good in both bills, much might be embodied in the latter that is absolutely necessary in the inventor's interest, and much might be abstracted from the former that is absolutely hurtful to him, even if it is in the small matter of augmented stamp duties, for the Attorney General proposes to add £82 10s to the present modest sum of £175. On the other hand Mr. Anderson wishes to reduce £175 to £85. The duration of the term of grant is in both cases to be 20 instead of 14 years. The Houses of Lords and Commons in Parliament assembled, would do a good turn, to the inventor, and more to materially increase the manufactures, and thereby the wealth and prosperity of the country—finding employment for our hardly pressed operatives—by "consolidating" all that is good in the two "amendments" and carefully eliminating from the Government measure objectionable features, such for example as compulsory licences, and all heavy and all deferred stamp duties. Let any "fortunate" inventor pay for increased profits like any other honest citizen to his income tax collector.

The prevention of boiler corrosion and incrustation the purification of the boiler feed water from condensers, and the obtaining of palatable drink by distillation of sea water are deservedly much thought of, and some clever busy minds are actively at work upon these, to us most important subjects. May full success attend their efforts.

STEAM-ENGINE ECONOMY.

BY CHARLES E. EMERY, M.E.*

IN writing a general report on the exhibits referred to the judges of Group XX., Centennial Exhibition, the writer compared the facts available in regard to the economy of steam-engines of various kinds on the uniform basis that the boiler is capable of absorbing 10,000 heat-units per lb. of coal consumed. This corresponds to an evaporation of 8·99 lb. of water at 80lb. pressure, 9·03 lb. at 60 lb. pressure, or 9·08 lb. at 40 lb. pressure from a temperature of 100 degrees in each case. This evaporation is higher than is usually obtained, but has been so much exceeded in practice,† that it is not considered too high for a basis of comparison. The basis, moreover, enables the duty of pumping engines and other steam machinery to be ascertained and expressed in a very ready and convenient manner. Ten thousand heat-units per lb. of coal is equivalent to one million heat-units per 100 lb. of coal, and as the duty of pumping engines is conventionally expressed in millions of foot-pounds per 100 lb. of coal, it follows on the basis presented that the number of foot-pounds per heat-unit represents also the number of millions of foot-pounds duty per 100 lb. of coal. The performance of all kinds of steam-engines may be readily compared on this basis. The simplest application is in testing vacuum pumps, the duty of which may be readily ascertained by noting the height of lift, and the initial and final temperatures of the water lifted. All the heat of the steam not expended in work enters the water, and the work performed lifts the same water. The difference in temperature gives very nearly the number of heat-units imparted to each pound of water lifted, and each pound of water so heated is lifted a certain number of feet high, so the result may be expressed readily in foot-pounds per heat-unit, which, as before stated, equals also, on the basis presented, the number of millions of foot-pounds duty per 100 lb. of coal. For ordinary comparisons the number of millions duty equals the lift divided by the difference between the initial and final temperature of the water. For more accurate computations, the divisor should be increased by the number of heat-units expended for work per pound of water lifted, which equals the height divided by 772. The height preferably should be calculated from the indications of a pressure-gauge at the bottom of the discharge-pipe so as to include frictional resistance. If D + duty in foot-pounds per 100 lb. of coal, H = the height of lift per gauge, and t and T = the initial and final temperatures, respectively, then,

$$D = \frac{1\,000\,000\,H}{T - t + \cdot 0013\,H.}$$

Arrangements have been made by the writer to use the same basis in testing pumping engines, by discharging water from the hot well into the suction of the main pumps, and noting with delicate thermometers the resulting increase of temperature of the water lifted.

A vacuum-pump tested by the writer in 1871 gave a duty on the above basis of $4\frac{7}{10}$ millions; one tested by Mr. J. F. Flagg, at the Cincinnatti Exhibition in 1875, reduced to the same basis gave a maximum duty of $3\frac{25}{100}$ millions. Several vacuum and steam-pumps tested on this basis at the suggestion of the writer about two years since, gave duties reported as high as 10,000000 to 11,000,000, the very small steam-pumps doing no better apparently than the vacuum pumps, which is by no means surprising. Elaborate experiments made with steam-pumps at the American Institute Exhibition of 1867,‡ showed that average-sized steam-pumps do not, on the average, utilise more than 50 per cent. of the indicated power in the steam-cylinders, the remainder being absorbed in the friction of the engine, but more particularly in the passage of the water through the pump. Again, all ordinary steam-pumps for miscellaneous uses require that the steam-cylinder shall have from three to four times the area of the water-cylinder to give sufficient power when the steam is accidentally low; hence, as such pumps usually work against the atmospheric pressure, the net or effective pressure forms a small percentage of the total pressure, which, with the large extent of radiating surface exposed and the total absence of expansion, makes the expenditure of steam very large. One pump tested by the writer required 120 lb. weight of steam per indicated horse-power per hour, and it is believed that the cost will rarely fall below 60 lb.; and as only 50 per cent. of the indicated power is utilised, it may be safely stated that ordinary steam-pumps rarely require less than 120 lb. of steam per hour for each horse-power utilised in raising water, equivalent to a duty of 14,000,900 foot-pounds per 100 lb. of coal on the same basis adopted for the vacuum-pumps. With larger steam-pumps, particularly when they are proportioned for the work to be done, the duty will be materially increased.

Ten thousand heat-units per lb. of coal represents an ultimate efficiency of only (10 000 + 100 ÷ 14 500=) 69 per cent. of the calorific value of anthracite coal, so that ordinarily more than 100—69=) 81 per cent. of the heat in the fuel is carried to waste up the chimney. A still greater loss is, however, experienced in utilising the steam for the purpose of work in the engine. The mechanical equivalent of one heat-unit is 772 foot-pounds, which, on the basis referred to above, corresponds to a duty of 772 millions of foot-pounds per 100 lb. of coal. The most economical steam-engines, for instance, pumping engines of approved types, utilise in the steam cylinder only about 130 millions, on the same basis, equivalent to an ultimate efficiency of (130 × 100 ÷ 772)= 16·84 per cent. of the heat in the steam, and but (16·84 × 69)= 11·12 per cent. of the calorific value of the fuel. The principal reason for this is that the exhaust steam necessarily carries to waste the heat required to maintain it in a vaporous state at the tension due to the back pressure. This, under the most favourable circumstances, forms the larger proportion of the total heat of the steam and reduces the opportunity for securing economy within small limits compared with theoretical limit, although the differences between the performances of different engines are great when compared one with another. §

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* Read before the American Society of Civil Engineers.

† See examples at p. 75 of the report referred to.

‡ See report of Messrs. Holmes, Seldon and Emery, judges, &c., Transactions American Institute, 1867-68.

Means for securing ecomony in steam-engines may be divided into two classes, viz., those of a mechanical nature and those which influence the thermal conditions. As to the first, the necessity of securing tight pistons and valves, ample area of cylinder passages, reduced clearances, &c., are well understood, also the incidental advantages due to a certain degree of compression. Those of the second class act to reduce the cylinder condensation, and include high speeds of revolution, steam superheating, steam-jacketing and the compounding of engines. High speed of revolution (which does not necessarily imply high piston-speed, as generally understood) secures economy, by reducing the time in which the transfers of heat to and from the steam and inclosing walls must take place. ‖

Superheating the steam has experimentally proved effective for moderate rates of expansion, in which the original temperature required to maintain the gaseous condition of the steam to the point of release was not too high to prevent proper lubrication. Mr. George P. Dixwell, of Boston, Massachusetts, has applied a thermometer to a steam-cylinder, by inspection of which it is possible to regulate the temperature so as to prevent injury to the metal surfaces. The great difficulty is, however, to secure a premanent and reliable superheating apparatus. Steam-jacketing has, to a limited extent, advantages of the same kind as superheating, and involves no serious difficulties in management. The jackets are most effective on long cylinders of small diameter. In experiments with United States revenue steamers, hereinafter mentioned, the economy of a steam-jacket on a comparatively short cylinder was found to be 11 to 12 per cent.

Compound engines, in addition to advantages of a mechanical nature, in better distributing the strains and rendering more uniform the rotative efforts, serve also to reduce cylinder condensation by the distribution of the differences of temperature between two cylinders. The radiation to and from the steam of its inclosing walls increases more rapidly than the difference in temperature so that the aggregate loss, when the difference of temperature is divided between two cylinders, is less than when it all occures in a single cylinder.¶ Moreover, the heat imparted to the exhaust steam by the metal of the first cylinder is available for work in the second, and the low-pressure piston acts as a screen between the high temperature in the small cylinder and the low temperature in the condenser.

It is still strenuously denied by many that the greater economy can be secured with a compound engine than with a long-stroke single engine, using the same steam pressure. There are coasting steamers of similar size running regularly in the United States, using both types of engine, with, it is claimed, substantially the same results ; but the boilers for the single engines are evidently the more economical, making an accurate comparison impossible. Strictly comparative experiments have, however, been made by Chief-Engineer C. H. Loring, U.S.N., and the writer with engines of different kinds in the steamers of the United States Revenue Marine, and by the writer with some of those of the United States Coast Survey.*

The revenue steamers were of the same size and the boilers very nearly identical. In one steamer was a compound engine with steam-jacketed cylinders ; in another a long-stroke high-pressure condensing engine (cylinder not jacketed) ; in another an ordinary low-pressure engine (cylinder not jacketed) ; and in still another, a high-pressure condensing engine with jacketed cylinder. The compound engine showed a saving of 12 to 16 per cent. compared with the best performance of either single engine when operated at the same steam-pressure. It is believed that substantially the same difference will be found in all cases when equally good engines of both types are compared. The performance of a shot-stroke compound engine may be equalled or even excelled by that of a long-stroke single engine, on account simply of the difference in clearance spaces and the superior efficiency of the steam-jacket in the latter case, but by making the compound cylinders in the same form they should still show an advantage. In practice, the economy of marine compound engines is greater than above mentioned, for the reason that the high steam-pressure is better maintained with them by the engineers than when single cylinders are used with high rates of expansion, causing difficulties in management.

The following table shows, in line one the performance of one of the Leavitt compound beam pumping-engines, at Lawrence, Massachusetts, and in line two that the engines of the *Rush*, one of the revenue steamers previously referred to :—

	Approximate steam pressure.	Ratio of expansion.	Diameter of small cylinder	Diameter of large cylinder	Strokes of pistons	Revolutions per minute.	Piston Speed.	Mean pressure referred to large cylinder.	Indicated horse-power.	Water per indicated horse-power per hour.
			Inches.	Inches.	Inches.		Feet per minute.	Pounds.		Pounds.
1	90	13·05	18	38	96	16·27	260·3	22·15	196·4	14·02
2	70	6·22	24	38	27	70·84	318·8	24·48	266·6	18·38

The comparison is very interesting. In both engines the larger cylinders are of the same diameter, but the difference in the duty for which the engines were designed require great differences in other proportions in all the details of construction. In the pumping engine for use on land there were no restrictions as to weight and space, so a comparatively long stroke could be employed and the connections made through a beam. The marine engine had, however, to be located in a small vessel, and was therefore directly connected and proportioned accordingly. Yet the long-stroke engine was run with so much expansion and at so slow a speed as to develop less power than the smaller one, and the latter was less economical, on account of the lower steam-pressure and rate of expansion and the relatively greater proportion of waste room in the cylinder, incident to the neccessary use of ordinary slide-valves. The engine of the *Rush* was, however, more economical than the ordinary stationary compound engines used for manufacturing purposes, as the latter, according to published reports in the engineering journals, require the evaporation of not less than 20lb. of water for each indicated horse-power. The Lawrence engine contains all well-know means for securing maximum economy of steam, and it is probable that few if any engines are working with greater economy in respect to the indicated power. The performance is, however, much below that given by calculation when all the conditions are taken into consideration, other than the slight distortion of the theoretical indicator diagram found in practice and the important loss due to cylinder condensation.

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§ In view of discussions in progress at the date of writing on the proper details of a theoretically perfect steam-engine, it is proper to mention that in the year 1868 the writer designed and partially constructed a non-exhausting experimental engine, in which the steam, after expansion in the cylinder, was to be circulated through another vessel, to withdraw the water due to the performance of work : the dry steam was then to be returned to the cylinder and compressed, which it was expected would require less power than the expansion would furnish, and sufficient steam only be received from the boiler to supply that condensed for work. A demonstration of the correctness of the principle only was intended, the power expected being so small that the experimental engine was to be connected to another to keep it in motion. Before the apparatus was completed the funds were diverted to objects of greater immediate necessity, and the subject is mentioned only as indicating the general principle upon which a theoretically perfect steam-engine may be constructed. See description of the apparatus in article on the "Theoretical Steam-engine," "Scientific American" Supplement, August 18th, 1877. See also Professor Thurston's calculations on a similar subject in "Journal of the Franklin Institute," October, November, December, 1877.

‖ The value of this saving was determined by the writer for the Novelty Ironworks, Mr. Horatio Allen, president, in the year 1868, and embodied in a series of tables showing the relative power and economy of different sizes of steam engines, which tables were aftewards published by Professor W. P. Trowbridge, the former Vice-President of the company.

¶ See article by the writer in "American Artisan," March 8th, 1871.

ON THE ACTION OF SEA-WATER OF THIN IRON AND STEEL PLATES.

By Sergius Kern, M.E., St. Petersburg.

THIN iron and steel plates were subjected to the action of sea-water in the following manner :—

The specimens were 0·076 metre square and 0·00317 metre thick (one-eighth of an inch). They were placed (four samples of iron, four samples of steel plates) in wooden boxes containing sea-water, 2 litres in each box. The sea-salt was obtained from the north shores of France and dissolved in water; the specific gravity was 1·027 when the salt was added.

The specimens were immersed in this solution for thirty days, next dried between filter paper, and finally in an air-bath at 35° to 40°; then they were weighed.

All the plates before the experiments had a smooth surface, and were of the best manufacture. The chemical composition of them being as follows :—

I. Steel Plates.

	Per cent.			
	I.	II.	III.	IV.
Carbon	0·290	0·300	0·180	0·234
Manganese	0·380	0·412	0·275	0·178
Sulphur...	0·010	0·010	0·012	traces
Phosphorus	0·005	0·008	0·010	0·032
Silicon	0·015	0·011	0·010	0·021

II. Iron Plates (average analysis).

	Per cent.
Carbon	0·110
Maganese	0·187
Sulphur	0·010
Phosphorus	0·004
Silicon	0·008
Copper	traces.

In the steel plates, in Nos. II. and III., traces of copper were observed. The other two steel plates contained no copper.

In the annexed table is shown the loss of the plates during the action of the sea-water upon them.

III.—Action of 100 Litres of Sea-Water (Sp. Gr. 1·027) on One Square Metre of Iron and Steel.

⅛-inch plates	Loss in grms.
1. Steel	22·75
2. „	22·34
3. „	21·83
4. „	21·96
1. Iron	25·78
2. „	25·54
3. „	26·04
4. „	27·44

To come to some conclusion further experiments are wanted, which are at the present time commenced, but the author believes that it is preferable to used steel for the skin of the ships. Certainly, in using steel much will depend on the manufacture and the composition of it, and many equivocal results may be obtained during experiments on the action of sea-water, owing to the more or less compactness of the plates. The best control in this case may be the determination of the specific gravity of the plates.—*Chemical News.*

STEEL LAUNCHES.

We have inspected two steel launches recently built by Messrs. Halsey & Co., Torpedo Wharf, Wandsworth. The *Tornado*, built for Mr. Louch, of Marlow, has attained a speed of 19 miles per hour, which is equal to anything yet achieved by a boat of her dimensions, viz., 50 ft. by 6 feet 6 inches. The hull is of steel, 3/32" thick, frames, also of steel, and the work throughout is excellent. She is fitted with a roomy teak cabin capable of accommodating 12 people. The boiler is of large capacity, built of steel, edges of plates all planed and holes drilled, fitted with brass tubes.

The Engines are of a very superior design and are constructed of phosphor bronze and steel throughout, and we understand they are capable of exerting 80 horse-power with 145 lbs. pressure per square inch on the boiler. They run without tremor or vibration, partly owing, no doubt, to the well designed screw propeller supplied to them, and to the thorough balancing of the moving parts.

The general appearance of the boat on the water is very fine.

TURNBULL'S PATENT EQUILIBRIUM SAFETY VALVES.

BOILER explosions are still unfortunately of too common occurrence, attended as they are with serious consequences, both to life and property. The question naturally suggests itself if explosions still take place, there must be something radically wrong in the appliances used to prevent them—the so-called "safety" valves. This fact is so notorious that not only the Engineering and Scientific Institutions, but private investigators have devoted much attention to the subject, and it is now admitted that the ordinary valve is inefficient, and fundamentally defective, and affords no real security, and this is more especially the case when boilers have been in use for a considerable time—many boilers burst at very little over their working pressure.

A proper safety valve should be extremely sensitive, giving perfect relief to the boiler the moment the pressure rises beyond that for which the valve is loaded. It should likewise be able, when necessary to give a full opening, and to discharge easily all the steam that can be generated by the boiler. It should also close promptly whenever the steam falls to the loaded pressure, so that no working power is lost.

The valves we now illustrate will be found to fulfil all these conditions. They are simple in construction, have ample discharging power and are more sensitive in steady lifting and prompt closing action than any heretofore introduced. The slightest difference in pressure makes them rise or fall.

These valves lift gradually from their seats, their action is steady, so that no vibration or sudden steam is brought to bear on the boiler—thus avoiding one of the chief causes of leaky joints. They are so guided that freedom of expansion is allowed to the working parts an important advantage as boiler explosions are frequently attributable to the defective modes of guiding, and as its action does not depend upon any peculiar steam curves, they are suitable alike for low and high pressures.

The valve shown by Fig. 1 is a dead load valve, and it consists of an inverted cylinder or bell chambered at its lower end and resting on a flat surface of small extent. The valve is guided externally at its lower extremity by six thin guides or ribs which project up from the valve seat as shown, while the upper end of the spindle (which is cast in one with the valve) is guided by passing through a brass ferrule fitted to a boss, which is connected by four wings to the escape pipe. The loading of the valve is effected by a cylindrical weight connected by four ribs to a central boss which fits on the top end of the valve spindle. This cylindrical weight imposes on the a valve a load of 20 lb. per square inch, and each of the ring weights, which may be added as shown, applies an additional load of 10 lb. per square inch.

An eccentric and easing lever is provided (as shown on the left hand side of Fig. 1) for raising the weights and blowing off when necessary, the effect of the easing eccentric being to turn the valve partially round each time it is used so that when it re-closes

Fig. 1

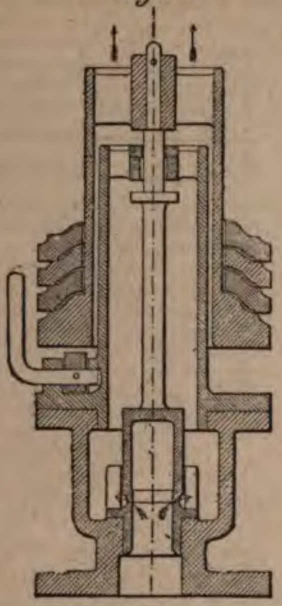


Fig. 2

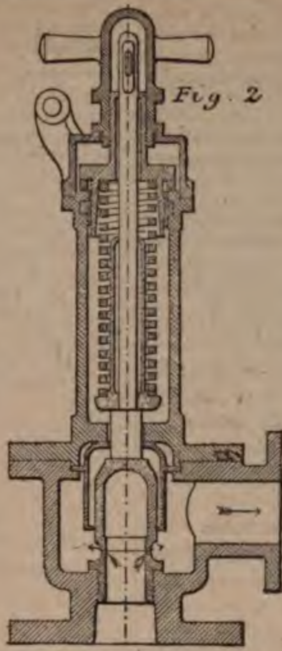
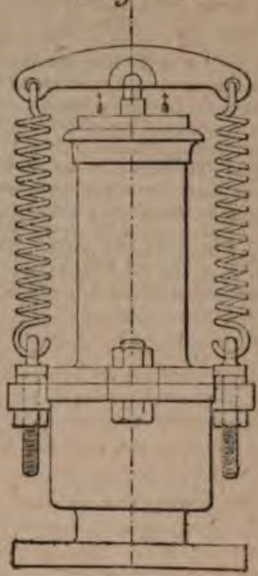


Fig. 3.



it comes down on a fresh bearing surface. Ordinarily the steam escapes at the open end of the vertical pipe, but when required this pipe is closed and a branch escape pipe cast upon its side or upon the side of the valve casing.

Fig. 2 shows a spring load valve for marine purposes. The form of the valve is similar to that already described, but the valve is guided externally at the lower end by a brass cylindrical casing, as shown, this guide having only a narrow surface in contact with the valve. The arrangement of the spring will be readily understood from our engraving, and it will be seen that the upper end of the valve spindle is guided by an extension of the spring-compressing nut.

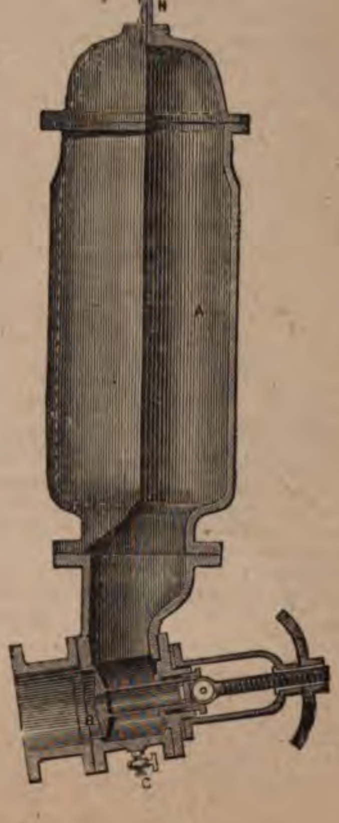
Fig. 3 shows a valve for locomotive, portable, and steam launch boilers, the internal construction being similar to that shown by Fig 1, but the load on the valve being imposed by two springs arranged as shown. The tension on the springs is adjusted by nuts on the eye-bolts at the bottom. When this construction is applied to a pair of valves, Messrs. Turnbull generally load the two valves by two springs only, the valves and springs being arranged in one line, an arrangement which the makers consider insures a more perfect adjustment of load on the two valves than can always be secured when two valves are loaded by a spring placed between them.

DUNLOP'S PATENT PNEUMATIC GOVERNOR.

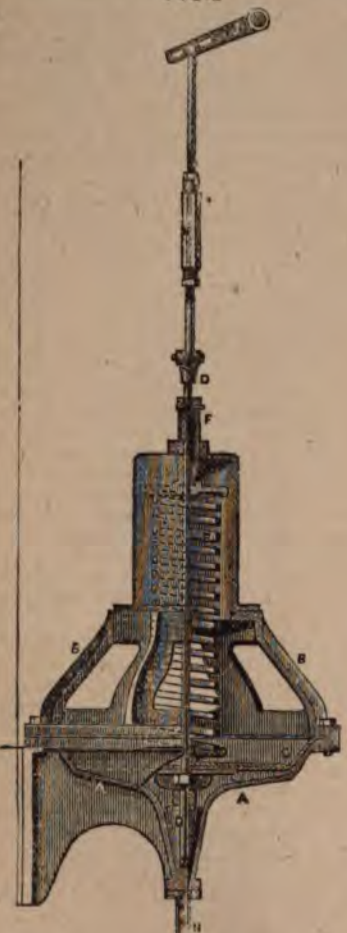
To the readers of the *Marine Engineering News* it would be out of place to point out the necessity of having a reliable marine governor. In cases which admitted of such an appliance acting efficiently, it was well described by an old engineer as "the odd man in the engine room," saving as it did, in heavy weather, the hard labour of one man standing for hours with the starting lever in his hand. The variety of marine governors is great, and the introduction of compound engines has necessitated some improvements and modifications in these contrivances to adapt them to altered conditions.

Mr. D. J. Dunlop, of the firm of Cunliffe and Dunlop, Port Glasgow, has extensively introduced a form of governor for which it is claimed that its action will affect the throttle valve before the screw has appreciably left the water, thus absolutely preventing the dangerous acceleration of the speed of the engines, shaft, and propeller, and preventing "racing" with all its attendant evils. Most other governors depend upon an increase of speed to obtain their action—this anticipates and prevents such increase. It would appear that Mr. Dunlop has "made his case," if not his fortune, judging from the extensive number of orders with which he has been favoured, not only for some of the largest and fastest steamers afloat in the Mercantile Marine, but also for several vessels in H.M. Navy. In one of the big swift Transatlantic boats, steaming out of Liverpool, the engineer states his "perfect satisfaction," while the captain adds that the governor is a source of great comfort in the saloon, the passengers being spared the jarring noise and vibration which was caused before its application by "racing."

FIG. I.

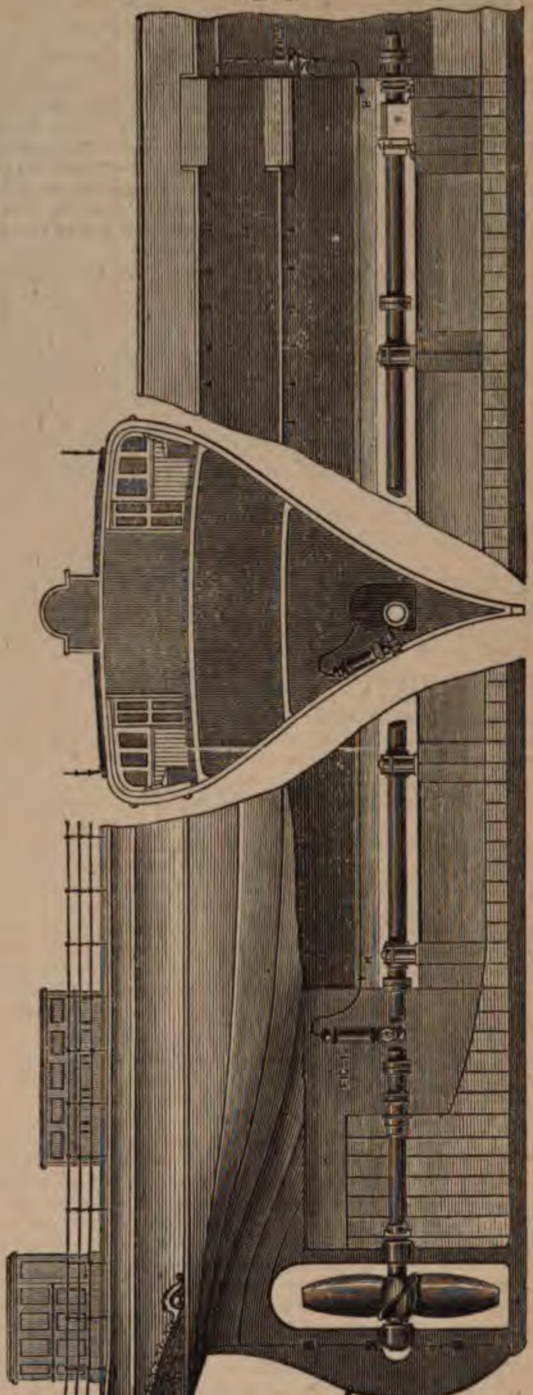


The construction and application of this governor will be readily understood by reference to the following description and the accompanying illustrations, in which Fig. 1 is an air-chamber, placed where convenient, in the after part of the vessel, if in a screw-steamer or alongside the paddles of a paddle steamer. By opening the sea-cock B, the inside of the chamber will be put in communication with the sea, and the air it contains be compressed to the pressure due to the height of the water outside. By means of the air-pipe H, which leads from the top of the chamber A through the screw-shaft tunnel into the engine-room, this pressure is transmitted to the apparatus represented by Fig. 2, which has its lower part A made perfectly air-tight by the india-rubber diaphragm C, which is securely bolted between the flanges of the parts A and B. In the upper part is placed the spring E, which can be compressed or relieved by the adjusting nut F to suit the water the vessel is drawing. Having filled the air-vessel, pipes, &c., with air, by means of the drain-cock C on Fig. 1 (and which should always be left open when the governor is not in use), and opened the sea-cock, the spring in Fig. 2 is compressed, and will remain so as long as the stern of the vessel preserves a uniform draft, or, in other words, as long as the screw-propeller remains immersed in the water. As the propeller emerges from the sea, and consequently the engines have less work to perform, the pressure decreases in the air-chambers, pipes, &c., and the india-rubber diaphragm C in Fig. 2 is forced down by the spring E, and steam valve acted upon through the connecting-link K (the length of which is adustable through a right and left hand nut in the centre), and the lever T, which may be placed direct upon the throttle valve. Fig. 3 is a representation of the general arrangement for the application of this governor.



The governor may be fitted to work the common throttle valve or the equilibrium valve of the largest engines, there being no practical limit to the power it may be made to exert.

FIG. 3.



It will be seen that the apparatus is simple and compact, and that there is no likelihood of its getting out of order. The all important feature is however that the engines are not allowed to "race" at all, the steam is cut off gradually from the moment the water begins to leave the propeller, and continues shutting off exactly in proportion as the stern of the steamer rises out of the sea.

WATER-TUBE AND FIRE-TUBE BOILERS.

An Account of the Experiments made by Chief Engineers Loring and Baker, U.S. Navy, on a Horizontal Fire-Tube and a Vertical Water-Tube Boiler, at the Washington Navy Yard, to ascertain their relative Economic Vaporization with different kinds of Coal

BY CHIEF ENGINEER ISHERWOOD, U.S. NAVY.

[*From the Journal of the Franklin Institute.*]

AT the time the compound engine was introduced into the Navy of the United States, several modifications were attempted of the ordinary cylindrical boiler employed with it. These modifications were made for the purpose of obtaining either better economic vaporizations, or of placing the grate and heating surfaces in a less breadth of shell; and among them was an arrangement, in a cylindrical shell, of vertical water-tubes immediately over the furnaces, in exactly the position occupied by the horizontal fire-tubes of the ordinary boiler.

This system of vertical water tubes which had been introduced with rectangular shells into the steamer of the United States Navy some eight years before the writer became Chief of the Bureau of Steam Engineering of the Navy Department, was continued by him after careful experiments had proven that, a pound of coal burned in the vertical water-tube boiler vaporized more pounds of water than when burned at the same rate in a horizontal fire-tube boiler having the same proportions.

The vertical water-tube boiler which was originally invented by the Earl of Dundonald, had been perfected in its constructive details by Chief Engineer Daniel B. Martin, of the United States Navy, and was known in America as the "Martin Boiler." It was, with the exception of a few merchant steamers, used exclusively in the Navy, where it always gave the greatest satisfaction; but in Great Britain it never attained the like success. The large steam-engine building firms, both there and in America, opposed its use, though certainly without regard to its engineering merits. These firms take contracts for a round sum to produce either stipulated horse-power, or a stipulated speed of vessel over a measured mile, independent of the weight of coal consumed; and as the vertical water-tube boiler is much heavier, more bulky and more costly for equal maximum weights of steam supplied per hour, and as they pay for the construction of the boiler, and not for the coal it consumes, they naturally prefer the cheapest type.

The vertical water-tube boiler obtains a great economic result from the coal, solely by virtue of the superior arrangement of its tubes for heat absorption; the furnace and smoke-connections being the same as in the ordinary type, and the position of the tubes relatively to them being also the same, whatever difference may be found in the economic result, must be entirely due to the tubes. In other words, of a given quantity of heat of given intensity thrown upon equal tube-surface in the two types of boiler in equal time, the vertical water-tube will absorb more than the horizontal fire-tubes; and, as a necessary consequence, the gases of combustion will enter the chimney at a low temperature and produce a less draught. One reason why the vertical water-tubes are more absorbent of heat than the horizontal fire-tubes, is that the former stands across or at right angles to the current of the gases of combustion, thereby continually breaking it up and commingling its constituents, each row of tubes being as a consequence impinged on by freshly mixed gases as they proceed from the back smoke-connection to the up take; while the horizontal fire-tubes, lying in the direction of this current, have no such mechanical action upon it, the particles of the hot gases entering at the smoke-connection end of a horizontal fire-tube retain their relative positions until they emerge from its uptake end, so that the same particles are in contact with the tube-surface from one end to the other during the second or two of their passage. Thus, the core, or central mass of the gases in each tube, may have at its exit a much higher temperature than its surrounding film in contact with the tube-surface; while, in the vertical water tube boiler, the mass of horizontally moving gases emerging into the uptake must have a nearly uniform temperature due to their thorough mixture by beating against and eddying around the vertical tubes which obstruct their progress. It highly probable, too, that the intimate intermingling of the gaseous current from the furnaces, effected by this mechanical action of the vertical water-tubes, causes the combustion of a portion of its constituents which might otherwise escape combination. Of course, the obstruction opposed by the vertical water-tubes to the current of the gases of combustion, mechanically lessens the draught of the chimney in addition to the lessening that results from the lower temperature of those gases comparatively with that of the gases entering the chimney from the horizontal fire-tube boiler; so that the vertical water-tube boiler has a less draught than the horizontal fire-tube boiler, both by the amounts due to the lessened temperature of the current of gases of combustion entering the chimney and due to the mechanical obstruction opposed to that current by the tubes as a consequence of their position. Hence, other things equal, the maximum rate of combustion in a vertical water-tube boiler is less than in a horizontal fire-tube boiler, and a greater quantity of the former is required to supply at the maximum the same quantity of steam in equal time as the latter, notwithstanding the greater vaporization per pound of coal consumed in the former. The greater economic efficency of the vertical water-tube boiler and its less potential efficiency, are thus inseparably joined as cause and effect when the draught is controlled by the chimney alone; but when mechanical means are employed to produce the draught, as a fan-blower for example, then, both in economic and potential efficiency is the vertical water-tube boiler superior to its rival.

In general, as the result of his very extended and carefully conducted experiments, the writer found that, other things equal, the rate of combustion at the maximum by the chimney alone in the case of the horizontal fire-tube boiler, was 50 per centum greater than in the case of the vertical water-tube boiler; but that the economic evaporization at those relative rates was 25 per centum less than in the latter, Hence, for equal quantities of boiler, the horizontal fire-tube produced in equal time, at the maximum 25 per centum, more steam than the vertical water-tube, but at an expense of 25 per centum more coal per pound weight of steam. In this fact will be found the principal reason of the little use by contractors for steam machinery of the vertical water-tube boiler; and their practice may, in measure, be defended for steamers making short voyages, but just in proportion as the voyages lengthen does that practice cease to be judicious. The engineer has to look upon the boiler and the coal to be carried as a whole, with a proportion between them variable according to circumstances. He has to consider that a certain space and displacement are allotted in the vessel to the two combined, and it is a test of his skill to so proportion them to each other, for the different types, as to obtain from them the greatest number of miles steaming. The greater the economic efficiency of a certain type of boiler, though accompanied by a less potential efficiency, the more of it and the less of coal can be properly placed in the vessel to steam a given distance at a given speed; and the less the economic efficiency of a certain type of boiler, though accompanied by a greater potential efficiency, the less of it and the more of coal can be properly placed in the vessel to steam the given distance at the given speed. The best type of boiler to be adopted, is the one which enables the vessel, with a given space and displacement assigned to boiler and coal, to make the given distance at the given speed, with the least coal. Hence, for naval steamers making long voyages, the vertical water-tube boiler gives better results than the horizontal fire-tube boiler, and better just in proportion to the number of days the vessel is required to be able to steam at the given maximum speed. Such were the considerations which led the writer to prefer the vertical water-tube boiler to the horizontal fire-tube boiler for the steamers of the United States Navy, and he believes their soundness will bear the closest scrutiny. The boilers he designed had rectangular shells, and were braced for a working pressure of 40 pounds per square inch, above the atmosphere; they allowed about 50 per centum more grate and heating surfaces to be placed in a given space than the cylindrical boilers carrying a pressure of 70 pounds; and it is very doubtful if any economic gain possible from the latter pressure can compensate the enormous increase of space required, especially when the value of space in a naval vessel is considered.

Compared with the horizontal fire-tube boiler, the vertical water-tube boiler, when steaming at the maximum over a given distance in a given time, is 25 per centum heavier, more bulky and costly; but it requires 25 per centum less weight of coal carried in the bunker. In weight and bulk, this less weight of coal offsets in measure the greater weight and bulk of the boiler, and if the time of steaming extends to eight or ten days, much more than offsets them, while the much greater cost during a year's steaming of the 25 per centum additional coal with the horizontal fire-tube boiler, more than offsets the difference of cost between it and the vertical water-tube boiler.

The circulation of the water and the extrication of the steam over the *entire* tube-surface, are much more rapid with the vertical water-tube than with the horizontal fire-tube boiler; and from these causes, the unit of surface in the former is much more efficient as a steam-producer, than the unit of surface in the latter.

All the water vaporised by the vertical water-tubes, is supplied to them from the space between the crown of the surface and the lower tube-plate, and, in ascending, is not obstructed by any mechanical impediments, but being guided by the mechanical tubes themselves, takes the shortest path, and rises with the maximum velocity due to the conditions of temperature and height of column, passing with this velocity over the *entire surface of the tubes*. Hence, in a given time, the greatest possible number of particles of water would be brought in contact with a given tube-surface, and the bubbles of steam formed on that surface would be swept off by that rapid circulation, with corresponding speed. These advantages accrue to the vertical water-tube by reason of the parallelism of the tube with the ascending column of water, and by reason of the tube protecting the entire ascending mass of water from being broken in upon by lateral currents.

But with the horizontal fire-tubes, these conditions are all reversed. Those tubes, lying at right angles to the ascending current of water, act as mechanical obstructions, and consequently impede its velocity; beside which, the water vaporised by the horizontal tubes is supplied to them, not only vertically from the water space between the lower row of tubes and the crown of the furnaces, but horizontally from the water spaces at the sides of each group of horizontal fire-tubes, and coming in between the rows as cross-currents to the ascending mass, break in upon and lessen its vertical velocity. Neither the vertical nor the horizontal cross-currents can pass with maximum velocity over the *entire surface* of the horizontal tubes, because that surface being convex in opposition to these currents, can have only a line swept tangentially by them with the maximum velocity, which, existing only in the *least* water spaces between the tubes, is able to sweep only a line of their surfaces vertically and horizontally. There must be, therefore, in a given time, fewer molecules of water brought into contact with a given tube-surface in the case of the horizontal fire-tube, than in that of the vertical water-tube.

With the vertical water-tube boiler, brass tubes are indispensable, as iron ones last only from one to two years, owing to the rapid corrosion of their lower ends. The lower one-fourth of an iron vertical water-tube will be corroded entirely through, while the upper-three-fourths will be unaffected, but brass tubes will much outlast the boiler. The corrosion of the iron tubes is nearly as rapid with jet condensers as with surface condensers, as it takes place almost entirely on the outside, being due to the sulphuric acid formed by the union of the sulpuorous gases from the coal, with the moisture deposited on the tubes during each interval of steaming. This weak sulphuric acid trickles down the tubes, and remains around their lower ends, where there is also, generally, most soot. When, as sometimes in land boilers, the steaming is continuous the year around, with only occasional interruptions for cleaning, the iron vertical water-tube is as durable as the iron horizontal fire-tube, but it should never be employed with marine boilers.

The sweeping and replacing of vertical water-tubes are a little more difficult than in the case of horizontal fire-tubes; but they are far easier to be cleaned of scale, which can be entirely removed from the interior of water-tubes, but only partially from the exterior of fire-tubes; and the former have the advantage that the water level can be allowed to fall fifteen inches below their upper tube-plate, without injury from heat.

The vertical water-tubes require for their extraction and replacement, a height between their upper tube-plate and the boiler shell equal to their length. This condition cannot be had in a cylindrical shell, but if brass tubes are properly put in and well cared for, there will be no occasion to replace one during the life of the boiler. In the original construction of the boiler, the tube-box can be made complete, independently, with the tubes secured in their plates, and the whole then riveted into place.

In the case of a horizontal fire-tube and of a vertical water-tube boiler differing only in the tubes, all the other portions being the same, and the total grate and heating surface in the one being the same as the total grate and heating surface in the other; the weight of the former will be a little less than the weight of the latter in metal alone, exclusive of the water contained, but if the water be included, then the weights of both boilers will be about equal.

A modification of the ordinary cylindrical boiler, with horizontal fire-tubes returned above the furnaces, called the "oval boiler," has been found convenient in practice as enabling the grate and heating surfaces to be placed in a less frontage. This so-called oval boiler has a semi-circular top and bottom of equal diameter, connected by flat vertical sides, making the highest of the boiler greater than its breadth by the height of these sides which are, of course, tied across by braces. Such a shell is particularly well adapted for vertical water-tubes, the height of the flat vertical sides being made the same as the height of the tubes, the tube-boxes being placed directly between these sides, and braced to them.

EXPERIMENTAL BOILERS.

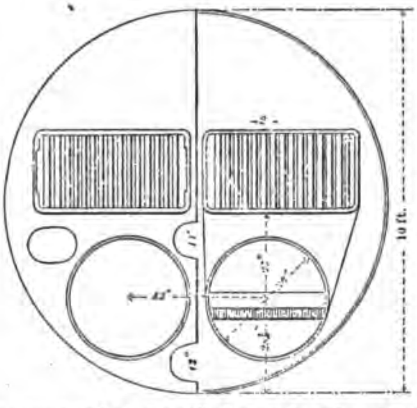
To test the mechanical feasibility, and the economic vaporization of such an arrangement of vertical water-tubes as could be placed in a cylindrical shell, comparatively with the economic vaporization by horizontal fire-tubes placed in a duplicate shell, the Bureau of Steam Engineering of the Navy Department, constructed at the Washington Navy Yard, two high pressure boilers of the marine type, for compound engines. The shells of these boilers were cylindrical, 10 feet in diameter, and 9 feet in length, exclusive of their sheet iron uptakes. Each shell contained two cylindrical furnaces 3 feet in diameter, with grates 6 feet in length. The two boilers were duplicates in all respects except tubes, those in the one being horizontal fire-tubes, and those in the other being vertical water-tubes; but, in both cases, the tubes occupied the same position, immediately above the furnaces. The heating surface of the tubes has been calculated for their inner circumference in both cases, and with this method of calculation the total heating surface of the horizontal fire-tube boiler is 1,019 square feet, or 28·30 square feet to one square foot of grate surface; while, in the vertical fire-tube boiler, the total heating surface is 1,104 square feet, or 30·67 square feet to one square foot of grate surface. In quantity of heating surface, therefore, the vertical water-tube boiler exceeded the horizontal fire-tube boiler $\left(\frac{1104-1019\times 100}{1019}=\right)$ 8·34 per centum, or about one-twelfth; but that this additional quantity had but very little influence on the economic vaporization, will be apparent when the rate of combustion (only 14·2 pounds per square foot of grate surface per hour, at the maximum) is considered, and the large proportion of heating to grate surface (28·30 to 1·00) existing with the boiler having the least heating surface. The cross area over the bridge-walls for draught, is the same in both boilers, namely 5·55 square feet, which is one square foot to each 6·40 square feet of grate surface. The proportion is the same through the tubes of the vertical water-tube boiler. but is much greater through the tubes of the horizontal fire-tube boiler, where it is one square foot of cross area to each 4·97 square feet of grate surface. This difference, in view of the fact that the cross area for draught over the bridge-walls is less than through the tubes, has no effect on the economic vaporization. The steam room in both boilers is of very nearly the same height and capacity.

The following is a detailed description of each boiler, together with its dimensions and proportions:

THE VERTICAL WATER-TUBE BOILER.

The shell of the vertical water-tube boiler is a cylinder with flat ends at right angles to its axis. This cylinder is 10 feet in diameter and 9 feet in length, externally; the uptake, which is of sheet-iron bolted to the front end of the cylinder, projects beyond this length. The plates of the shell are eleven-sixteenths of an inch thick and double riveted. The flat ends of the shell above the tube-boxes are stayed directly across with iron rods 1⅝ inches in dameter and 10 inches between axes, attached to double angle iron riveted vertically to the ends. All other flat ends are stayed with socket-bolts 1⅛ inches in diameter and 6 inches between centres.

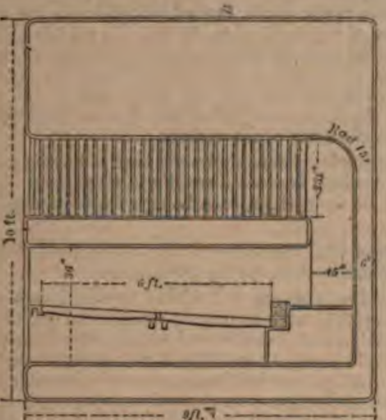
FIG. 1.



There are two furnaces contained in horizontal cylinders of 3 feet internal diameter and 7 feet 3 inches extreme length. The axes of these cylinders are in the same horizontal plane and 42 inches apart. The cylinders are composed of iron-plates, ½ inch thick, butted, and double riveted to inner welts below the grate-bars; they are single riveted to the boiler shell, and are in two lengths, flanged where the lengths meet at the centre and single riveted thereby. The grates within these cylinders are 6 feet in extreme length composed of cast-iron into lengths of 3 feet each. The bridge-wall is cast-iron faced with fire-brick, and is 6 inches high above the level of the grates. The top of the grates is 18 inches below the crown of the furnace at the front, and 21 inches below it at the back.

Each furnace has a separate back connection 15 inches long lengthwise the boiler, with its top rounded on a quadrantal arc of 13 inches radius. Its back is flat and separated from the boiler shell by a flat water-space 6 inches wide, including thickness of metal. The bottom of the connection is a horizontal extension of the bottom of the cylinder containing the furnace, and the sides are flat. The inner side is vertical and rises from the horizontal diameter of the furnace. The outer side, at the top, is a horizontal extension of the vertical side of the tube-box, from the lower edge of which it slopes inwards on a tangent to the cylinder containing the furnace. The cast-iron bridge wall of the furnace is extended clear across the connection, so as to occupy the whole of the lower portion.

FIG. 2.



Here are two horizontal tube-boxes, one to each furnace, and they are returned directly above the furnaces from the each connections to the uptake. These boxes are rectangular, 23½ inches high and 47 in. wide in the clear, with an extreme length of 7 feet 3 in. They are composed of ½ inch thick iron plates, flanged and single riveted. Their tops and bottoms are the upper and lower tuble-plates, and their sides are stayed to each other and to the boiler shell by socket-bolts. The space in the clear between the top of the cylinders containing the furnaces and the bottom of the tube-boxes is 8½ inches.

To be continued.

ON THE FITTING OF SCREW SHAFTING.

BY MR. THOMAS E. RAWLINSON, PORT ADELAIDE, SOUTH AUSTRALIA.*

WITHIN a comparatively short space of time we have had a number of serious disasters off the Australian coast, in the loss of screw steamers under peculiar circumstances.

The s.s. "Dandenong," whilst on her passage between Melbourne and Sydney (11th November, 1876), in very heavy weather, began making water fast aft, and before the whole of the crew and passengers could be removed, she disappeared. The night was dark and stormy, and her loss was only surmised at the time by the survivors and the crew of the vessel near to her, owing to the sudden disappearance of her lights.

More recently the "City of Hobart," laden with coals from Newcastle, had to be abandoned, and sunk within fifteen minutes afterwards. The captain stated that a report and shock were heard and felt under the stern, and the vessel immediately began to fill with water, owing, as he supposed, to injury done to the ship, due to the fracture of the screw or shaft.

As it rarely happens that any evidence is left as to the exact cause of the injury sustained under such conditions, we can only reason inferentially on the matter; but in each of these cases the conclusion is almost irresistible that the loss of the vessels in question was due to fracture of the screw shaft, and rupture of the skin of the vessel.

When the subject is considered in connection with the whole of the surrounding circumstances, we need scarcely be surprised at such a mishap occurring occasionally, but accept it as proof of the generally excellent character of material and workmanship, that it is not of more frequent occurrence during such periods when the ship is heavily straining in broken seas during bad weather.

My object in penning these few notes is to offer a few remarks on the probable causes of these failures, and suggest a mode of dealing with them which may serve to mitigate the great evil of a total loss from such causes, pending the discovery of some method of obviating the original source of the mischief.

I need not occupy time by dilating on the character of all ships' hulls, whether of wood or of iron, in reference to their mobility, or power of yielding, in a greater or less degree, to the forces and strains acting upon them; or that it is scarcely possible, even if desirable, to build a vessel which shall be absolutly unyielding and stiff in every position.

That such a condition of hull is recognised by the society as one of mobility, is evidenced by a paper read recently by one of the members on new form of coupling for screw shafts, with a view of rendering them more susceptible to the yielding form of the ships' hulls, although the general opinion appeared to be that at present the rigid form of screw shafting is a necessity.

The above being understood, we have two opposite conditions in hull and shaft—namely, mobility and rigidity—and there must as a consequence be a great and dangerous strain somewhere, and the weaker body must yield to it.

In the case of screw shafts, a consequence of such strains must be a large amount of tension and of bending combined, which, continued for a sufficient length of time, must affect the structure of the iron, rendering it more brittle, and liable, under some unusual strain, to snap with great violence. From this cause wrought-iron which left the manufacturer's hand of the best and most suitable character, becomes, through constant use, changed in structure, but of this change there is no outward visible sign to warn the engineer.

I am not aware that any authenticated experiments have been made to test the rapidity or quantity of the deterioration in screw shafting such as were conducted some years back by a Royal Commission to ascertain the effect of concussion and deflections in other forms of iron, but I hope it will be made an item in such experiments in any future series undertaken.

At present we have a knowledge of the evils—namely, mobility of hull and rigidity of shafting, with consequent fracture and piercing of the skin of the ship, and consequent loss of life and property; and as we have have not yet arrived at the knowledge of how to obviate either, I have to suggest a meams of reducing the evils to a minimum by fitting the after part of the ship, between the engines and the stern post, with water-tight bulkheads across the breadth of the hull and the shaft tube, the fitting around the shaft being made with water-tight collar, sliding, or rather revolving, in a packed joint in the tube. The inspection of the shafting and bearings should be made, by proper hatches from the deck, so as to ensure at all times and under all circumstances a close water-tight diaphragm across the ship's hull.

This question is, as I am aware, surrounded by many difficulties, and, with this knowledge, I only offer my suggestions for what they are worth for the consideration of the Members.

Within the last few weeks the ocean steamer "Cuzco" fractured her shaft at sea, but without serious loss, other than detention on her voyage and necessary charges for repairs; but she furnishes a further illustration of the danger arising from this weak point in the machinery of a ship. Many such instances must be within the knowledge of the members, of fractures occuring in shafting provided by some of the best and most noted of our shipbuilding firms, who are eminent for skill and the excellent character of the materials and workmanship supplied by them. The weakness is a defect which, if it cannot be wholly remedied, may, I think, be reduced in its ill consequences within certain narrow bounds, and if it does not obviate wholly the loss of property, may limit risk to, and loss of life.

In the after discussion, and on the invitation of the President,—

Mr. JOSIAH M'GREGOR said with regard to the remarks in the first part of the paper, where it was stated that a number of serious disasters had occured off the Australian coast caused, doubtless, in connection with the screw bearings of the ship. He did not think that within the last 10 or 12 years in screw vessels, he had met with a single instance of the skin of a ship having been ruptured by the breaking of the screw shaft. The stern pipe was often broken and water passed through into the tunnel. He did not agree with the author that there were no indications given of a shaft being weak. He thought that if shafting was properly inspected, and looked after that, very often, if not in the majority of cases, accidents could be avoided and defects ascertained that would otherwise, if inspection were not properly attended to, be put down as unavoidable. When a shaft was painted it showed flaws on the paint by oil appearing in beads or on the surface of the paint. If these defects were carefully noted and marked, and the cracks observed to be extending, then that was a sign that the shaft was really defective. Almost weekly he was in the habit of discarding shafts from seeing extension of cracks, no other indication of weakness existing than a slight extension of the flaws thus noted.

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* Paper read before the Institution of Engineers and Shipbuilders in Scotland

Mr. G. RUSSELL remarked that he agreed with the writer of the paper in supposing that instances of screw steamers disappearing at sea might be caused by the screw shaft, after breakage, making an extensivé rupture in the hull.

Mr. D. ROWAN thought the author was wrong when he said that the hull of a ship was more elastic than the shafting. The shaft is like a wire in the middle of a great structure which cannot yield. It is a rare thing to have a broken shaft. He could not remember a case of that kind which had come under his notice. Before they had the *lignum vitæ* bearings the after bearings were the source of great trouble. He remembered when they used to bore the the stern tube right through, forming a bearing of cast-iron the whole length of the stern tube, in the case of a large steamer where they had made the fit too neat, before the vessel reached Cumbrae Head the malleable-iron shaft and the cast-iron pipe had got burned together and burst the pipe; but nothing went wrong although a little water came in. The most difficult thing that he had ever done was to take that shaft out of the pipe. He had to put it in strong bolts to tear up the pipe before the shaft could be got out. In the present state of engineering and forging of shafting there was far better workmanship and better appliances, both hammers and furnaces, now than 15 or 20 years ago. Then they had not so much experience as now. He thought they had rarely bad shafts in vessels. He did not know himself what it was to have a bad shaft, and he had no information of cases like what the author had brought forward.

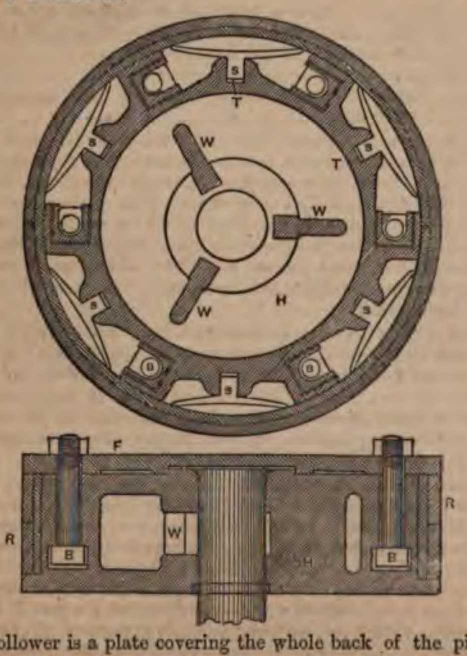
Mr. KEMP, concurred very much in what Mr. Rowan had said. He thought the ship could take care of herself.

PISTON FOR STEAM-ENGINES.

BY J. H. COOPER.

THE body H of the piston is of the box form, giving greatest strength with least weight of material, and is strengthened by webs or struts W, formed in the central core, which latter is all removed by way of the openings made for the rod.

On the outer face of the piston, two sets of cavities are cast, one of parallel notches for the springs S. and one of recesses for the bolts B. so arranged that gravity holds the bolts in place when the follower F is removed.



The follower is a plate covering the whole back of the piston, to protect the riveted end of the piston-rod, and is centred on a boss of the piston.

The follower-bolts, are of the common kind, with square heads fitting the recesses and may have ordinary nuts outside; but square nuts of brass are best, since, if they drop off, they will be mashed without injury to piston, rod, or cylinder.

The springs are of steel, each cast with a rib across the centre of the back, fitting the groove in the piston, without the need of machine work or tempering. The bottom one S', may be replaced by a solid block for carrying the weight of the pistons, necessary in horizontal engines.

The packing rings are three in number, two outside against the cylinder breaking joint in the usual way, and one thinner inside against which the springs act.

In any adjustable steam piston, the most important features are the readiness with which the adjustment can be made, and the permanence of the same when made. To set the springs out in this piston, parallel lines T, best of non-corrosive metal, are forced into the recesses, of the piston against the ribs on the springs. When so placed, and the follower put on, there can be no change in the position of the rings, except such as may arise from wear of the same, or from the elasticity of the springs.

Experience with pistons shows the need of having perfect command of the rings, which is secured readily in this piston by the liners T at the back of the springs, each being adjusted independently of the others.

Six years of trial have proved this to be a good piston, holding its adjustment and requiring very little attention.

It was said as long ago as 1838, by Tredgold, that—"The rubbing surface of a piston must be pressed against the cylinder with a force at least equal to the pressure of the steam it confines, otherwise the surfaces would separate and the steam escape," and much of our experience with pistons has proven the truth of this statement. To gain this essential feature, we make the springs very strong, as shown in the sectional plan of the cut which represents an 18 inch piston.

In a truly-bored cylinder the motion required of piston springs is little, but the registering force must be great if the rings are sufficiently steam-tight to prevent the full pressure of steam getting back of the rings, and this condition can only be had by stiff springs, which also protect the cylinder from abrasion by the edges of the piston-head and follower, since the springs are frequently too weak to keep the piston in the centre of the cylinder, free from contact with its walls.—*Polytechnic Review.*

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions referred therein. We will with pleasure insert any letters likely to benefit our readers either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience. All communications must, however, be condensed, so as not to infringe upon the limited space we can afford.*—ED.]

INSTITUTION OF MECHANICAL ENGINEERS.

TO THE EDITOR OF THE "MARINE ENGINEERING NEWS."

SIR,—I am instructed by the Research Committee of the Institution to bring to your notice the three subjects (as below) which they selected for first investigation; and to enquire whether you have any information, bearing on all or any of them, which you would be willing to communicate, *e.g.*, records of unpublished experiments, references to authorities on the question, copies of books or papers in which it is treated, &c.

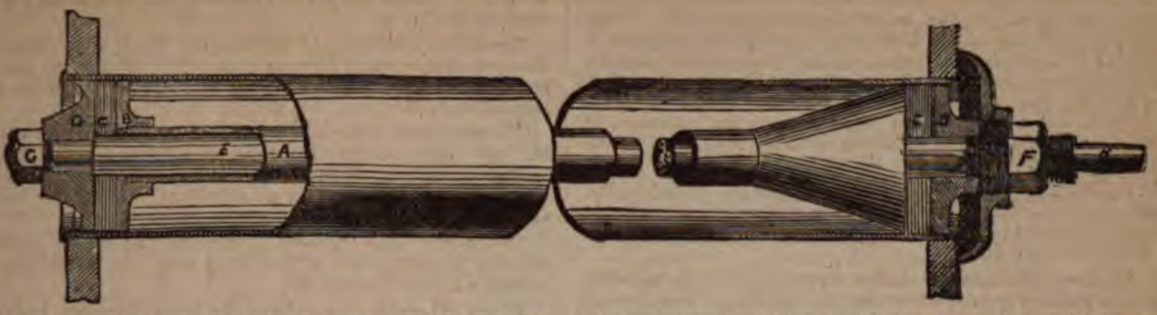
The Committee would be glad to receive such information in full detail, and at the earliest convenient date; and it will be suitably acknowledged in their report,

Yours truly,
WALTER R. BROWNE, Secretary,
10, Victoria Chambers, Victoria Street, Westminster.
March, 1879.

Subject A. The hardening, tempering, and annealing of steel.

Subject B. The best form of riveted joints to resist strain, in iron or steel, or in combination.

Subject C. Friction at high velocities, specially with reference to friction of bearings and pivots, friction of brakes, &c.



BOAZ'S PLAN FOR STOPPING LEAKY BOILER TUBES.

We have, from time to time, in these pages, noticed several appliances for stopping leaky boiler tubes, and our list would be decidedly incomplete were we to omit Mr. Boaz's most simple and efficient tube stopper, the use of which has saved many vessels from having to put into port to repair tubes, a fact which deserves notice of shipowners as touching them in a tender part. A reliable authority, Mr. Charters, superintending engineer, testifies to their being very simple in application, and that they can be fitted in a few minutes without drawing of fires and sending a man into the combustion chamber or any detention of the vessel. There is no danger in applying them, and no necessity to reduce pressure on the boiler, the stopper having in some cases been put in at a pressure of 65 lbs. per square inch. The saving of time and fuel in drawing fires is a most important item, and the risk of stopping a tube from the back end is avoided. No steam-ship should go to sea without them, and all sea-going engineers should indent for a Boaz stopper.

The construction of these stoppers will be readily understood from the engraving. When it is required to apply the apparatus when steam is up, pass it through the leaky tube from the front end of the boiler, screw up the nut which, expanding the india-rubber washers, will make the tube perfectly tight at each end. A shield is provided to prevent any escape of water or steam while the apparatus is being applied, the whole operation taking but two or three minutes.

SOCIETIES, INSTITUTIONS, LECTURES, ETC.

The Latest Improvements in Marine Engines and Boilers, by Mr. John R. Ravenhill, M.I.C.E. Abstract of a Paper read before the Royal United Service Institution, Whitehall.

THE lecture was illustrated by diagrams and well-executed models. The reader of the paper drew attention to the vast strides made in ocean travelling by the use of the compound engines adopted by the Inman Line, as well as by the Australian traders, as Messrs. Money Wigram and the British India Steam Company, and dwelt upon the long prejudice existing against this class of engine after the explosion of the Cricket steamboat on the Thames, where the Adelphi-gardens now are, in 1847. In time, however—but many years had glided away—the advantages of the compound engine, working from 40lb. on the square inch and upwards, became so apparent that it had come to be the engine of the day. Pressures had been increased in trans-Atlantic vessels to 90lb, on the square inch, and machinery to indicate 5,500 horses was being constructed for the Navy to work at a pressure of 120lbs. per square inch on the boilers. Generally during tke last two years steamship owners and others had been endeavouring rather to perfect what had been already done and profit by their experience than to introduce new schemes. Boilers are now being mode of iron 15ft. in diameter and upwards, with a thickness of casing plates 1 5-32in., and with pressures creeping up to 90lb. on the square inch. Boiler-making can no longer be left in the hands of the ordinary boiler maker; it has become imperative that all the various laps, joints, and butt-plates should all be fitted together by first-class workmen. The cylindrical form of boiler is universally adopted, and the pressure proposed for new boilers is fast approaching the average of 80lb. on the square inch; they are on the return tube system, and have circular fire-places and are fired at one or both ends as may best suit the requirements of the vessel. He then proceeded to speak of the use of steel for boilers, and he referred to the rules passed by Lloyd's on this subject. These rules were necessary, as the material was injured to the extent of 33 per cent. of its ultimate strength by the mere operation of punching; but by riming the holes out to 1 16-in. larger, or by annealing the plate after it had been punched, the whole of the strength was returned. He entered at length [into the experiments which Lloyd's Committee is carrying out with regard to boilers, and then dealt with the subject of marine engines used in the Royal Navy made of Sir Joseph Whitworth's fluid-pressed steel, and he showed how, by the use of this material, great weight had been saved on the ships, thus lessening the quantity of coals consumed. All the other improvements in steam gear were described in detail.

Glasgow Fairfield Association.—The usual meeting of this association was held March 12, Mr. W. Cook, vice-president, in the chair, when a paper on "Steam in the Engine" was read by Mr. Robert Wyllie, president of the association. The paper was listened to with great attention, and at its conclusion Mr. Wyllie was awarded a hearty vote of thanks.

SHIPBUILDING, TRIAL TRIPS, ETC.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the MARINE ENGINEERING NEWS as complete and reliable as possible, and will thankfully receive all such information or accounts of any novelties relating to any branch of the marine engineering trades. *To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

Inch Clutha, this vessel, has been tried under steam at sea. The *Inch Clutha* has been built to the order of Messrs. Hamilton, Fraser, and Co., of Liverpool, by Messrs. Mitchell and Co., of Newcastle-on-Tyne; the length of the vessel is 292 feet, breath 35 feet, and depth of hold 25 feet. She has a topgallant forecastle for crew, and full poop, which is, along with the deck-house, made of iron, as also is the main deck. She is made for water-ballast throughout, has been built upon the latest and most approved principles, and is classed 100 A 1 at Lloyd's. The steamer has been fitted with powerful engines, by Messrs. R. and W. Hawthorn, of Newcastle, and the boilers are of steel. The hull and machinery have been constructed under the supervision of W. R. McKaig and J. Carlton Stitt, consulting engineers, Liverpool. The owners, shipbuilders, engineers and a party of friends were present, and the trial was in every way a success.

February 22nd, a steamer, *Robert Dickinson*, was launched from the shipyard of Messrs. Leslie and Co., Hebburn. The vessel is intended to carry over 2,000 tons. She has been built for Messrs. Bell and Symons, Newcastle, and is intended for the Atlantic and general trades. The measurements are about as follows:—270 feet long; 34 feet beam, and 24 feet deep. The engines are by Mr. John Dickinson, Sunderland, and are of 160 horse-power, with full complement of steam winches, auxiliary boilers, &c. She has a double bottom for water ballast, &c. The cabin stands amidships, and there is a raised bridge 100 feet long. The steamer is of the highest class at Lloyd's.

February 22nd there was launched from the yard of Messrs. Palmer and Co., Jarrow, the screw-steamer, *Capri*, built for Messrs. Nicholson and Sons, Liverpool. The steamer measures 255 feet by 33 feet by 26½ feet, and will carry a deadweight of 2,200 tons. She is classed 20 years at Liverpool, and will be engined by compound surface-condensing engines of 150 horse-power nominal. The steamer is intended for general trade.

February 27th the screw-steamer *Dowlais*, built by Messrs. Palmer and Co.'s Iron and Shipbuilding Company (Limited), Jarrow, for Messrs. Morel Brothers, Cardiff, was taken out to sea for her initial trip. The *Dowlais* measures 240 feet in length by 33 feet beam, and 16 feet depth of hold; she is registered 1,092 tons gross and 710 net, with a carrying capacity of 1,650 tons deadweight. She is classed 100 A 1 at Lloyd's, and engined by the same firm with a pair of inverted direct-acting compound surface-condensing engines of 120 horse-power nominal. The *Dowlais* was steamed over the measured mile a few times, the average of the runs yielding a mean speed of 11 knots per hour, a result which was considered highly satisfactory. The engines worked with great smoothness, The *Dowlais* is built especially for the Bilbao trade, and is the third vessel built by Messrs. Palmer for Messrs. Morel Brothers.

March 8th, the new screw steamer *Hugh Sleigh*, which has been built by Messrs. Palmer and Co. (Limited), Jarrow, for Messrs. J. and R. Bovey, of London, went out to sea for a trial trip. The vessel is 242 feet long,, 33 feet broad, and 20 feet deep. Her engines are of 140 horse-power nominal, the cylinders being 31 inches and 58 inches in diameter, and the stroke of the piston 36 inches. The steamer is classed 100 A 1 at Lloyd's, her gross registered tonage being 1,411 tons. The vessel was built under the superintendance of Captain Pinkham, by whom she will be commanded; and the engines were constructed under the superintendance of Mr. Churchill, of London. After the compasses had been adjusted, the speed of the steamer was tested by running four times over the measured mile, with and against the tide, the mean speed being 10½ knots per hour. The trial trip was considered very satisfactory. At the conclusion of the trial, the vessel returned to Tyne to the take in a cargo of coals in the Northumberland Dock for the Mediterranean.

March 10th a new screw-steamer was launched from the yard of Messrs. Palmer and Co. Jarrow, named the *Radnor*. The dimensions of the vessel are:—Length, 245 feet; breadth, 32 feet; depth of hold, 19 feet; carrying capacity, 1,700 tons; engines 120 horse-power. The *Radnor* has been built to the order of Messrs. John and Herbert Cory, Cardiff, and is the seventh built at Jarrow shipyard for that firm. The superintendent is Captain Tyack.

An iron-built paddle tug-steamer, built to the order of Messrs. J. P. Rennoldson and Sons, South Shields, for the Clyde Shipping Company, Glasgow, and Greenock, has had her trial trip in the river and at sea. The *Flying Scotsman* measures 98 feet in length by 18 feet beam, and 9 feet 6 inches in depth. She is furnished with iron bulwarks, and has a cabin, saloon and berth, at the after end. The hull was built by Mr. J. T. Eltringham, Stone Quay, South Shields, and the engine which is a direct-acting surface condenser, of 70 horse-power nominal, by Messrs. J. P. Rennoldson and Sons. The *Flying Scotsman* after a short trip on the river, was taken out to sea for a run to the north; and though a gale of wind was blowing from the south-westward, she proved to be a good sea boat as well as a swift one.

March 15th the steamship *Estella*, built by Messrs. John Readhead and Co., South Shields, was taken on her trial trip. The *Estella* is a vessel 225 feet in length, 30 feet in breadth, 16 feet deep, and a deadweight capacity of 1,250 tons. She is fitted with compound surface condensing engines of 99 nominal horse-power, also built and fitted by John Readhead and Co. The vessel, in her runs over the measured mile, attained a speed of 10½ knots per hour, and in every respect gave the greatest satisfaction to her owners. She has been built to the order of Captain John Lewis, of Aberdovey, and partners.

March 8th there was launched from the yard of Messrs. Short Brothers, Sunderland, a screw-steamer, *Ashburne*, built to the order of Mr. J. S. Barwick add partners, of Sunderland, of the following dimensions: Lenth, 300 feet; breadth, 38 feet; and 25 feet depth of hold with a carrying capacity of 3,200 tons. This vessel is built on the three-decked principle, and has a long poop extending over engines and boilers amidships, and topgallant forecastle. The cabins aft are fitted up for the accommodation of captain and officers; the engineers' berths are amidships. The topgallant forecastle is fitted up in separate compartments for the accommodation of seamen and firemen. She is fitted with water ballast fore and aft, being divided into separate compartments under engines and boilers. She is also fitted with steam steering apparatus, four steam winches, steel tow-line, iron lower masts, patent windlass, and all the latest improvements. All the decks are of iron. This is the largest vessel built on the Wear for Sunderland owners, and registered in the port. She is also fitted with engines of 200 horse-power by Mr. Dickinson, of Palmer's Hill, Engine Works, with all the latest improvements. She is intended for the American trade, and will be commanded by Captain Hall.

March 12th Messrs. Wm. Gray and Co., of West Hartlepool, launched an iron screw-steamer *Gertrude*, built to the order of Messrs. Otto Trechmann, Consul to the German Empire at West Hartlepool. Her dimensions are:—Length between perpendiculars, 243 feet 9 inches; breadth, 32 feet; depth of holds, 18 feet 6 inches, and 22 feet 6 inches. Her gross tonnage is 1,370 tons; deadweight capacity, 1,850 tons; classed A 1 at Lloyd's; and built under the special survey of Messrs. Day and Fawcett, of Hartlepool. Engines, 150 horse-power, by Messrs. T. Richardson and Sons, of the Middleton Ironworks. The ship is built with complete double bottom for water ballast, raised quarter-deck, long bridge, topgallant forecastle for crew, iron decks, iron mast, iron rising chock, three powerful steam winches, steam windlass, and all the latest improvements to make her a first-class cargo ship.

February 22nd Messrs. Edward Withy and Co. launched from Middleton shipyard, Hartlepool, an iron screw-steamer, *Rovaima*, built to the order of Mr. George Steer, for Messrs. Steel, Young, and Co., of London and West Hartlepool. This vessel is the twelfth launched by the builders for the same owners. Her principal dimensions are:—Length, 225 feet; breadth, 31 feet; depth, 17 feet 2½ inches; and she has long quarter-deck, bridge, and topgallant forecastle, water ballast in both holds, and iron house for passengers. The rails round main and quarter-decks are built of iron, and the vessel will be schooner-rigged. The engines are of 100 horse-power, and supplied by the well-known marine engineers, Messrs. J. Richardson and Sons, of Hartlepool Ironworks.

February 22nd an iron screw-steamer, *Cymbeline*, was launched from the yard of Messrs. Richardson, Duck, and Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length, over all, 256 feet; ditto, between perpendiculars, 248 feet; breadth extreme, 32 feet; depth in hold, 18 feet 6 inches; ditto, moulded, 19 feet 7 inches; tonnage, owner's measurement, 1,246 tons; ditto, gross new measurement, 1,374 tons. She is classed 100 A 1 at Lloyd's, and has been built under special survey. She has a long quarter-deck, extending to engine-room, a bridge over engine and boiler spaces, with part of it fitted up for the accommodation of officers, and engineers, and a topgallant forecastle fitted up for the crew. The vessel is supplied with three steam winches for loading and discharging cargoes, and is fitted with Harfield's patent windlass. Her engines are on the compound direct-acting principle, built by Messrs. Thomas Richardson and Sons, Hartlepool, and are of 120 horse-power, with cylinders of 29 inches and 55 inches diameter, the length of stroke being 33 inches, with a working pressure of 75 lb.

February 22nd the first of the steamboats, the *Teaser*, for the Imperial Tramways Company was launched from the yard of Ms. S, S. Welch, Stockton. The vessel is 65 feet long, 12 feet beam, and will carry 120 passengers, with two pairs of engines driving twin screw. Her cabins will be large and commodious, very similar to the inside of tram cars, with which she runs in connection between Stockton and Newport.

March 8th the steamship *Cephalonia*, which has just been completed by Messrs. Raylton, Dixon, and Co., of Middlesborough, to the order of Messrs. Vagliano Brothers, of London, for Signor Stathopulo, of Naples, left their yard for trial trip of ship and engines. Her extreme length is 250 feet, breadth 31, feet and depth of hold, 17 feet 6 inches, giving her a carrying capacity of 1,650 tons, and gross register of 1,200 tons. Her engines are of 120 horse-power nominal. She has water ballast in both holds, and long raised quarter-deck, cabins aft for a few passengers and accommodation for officers under the bridge, and is fitted with three steam-winches and special hatches for grain trimming as she will be principally employed in Black Sea trade. She has been built under the inspection of Captain Papalas, who, along with the company assembled on board, expressed their extreme satisfaction with the construction of ship, and the successful trial trip. After an hour or two's run she put into the Tyne where she will load in the Tyne Dock for Naples.

March 24th, Messrs. Raylton, Dixon and Co., launched from their yard an iron screw-steamer 245 feet long, 33 feet beam, and 16 feet depth of hold, which will carry 1,513 tons at 16 feet draft. She has iron decks fore and aft; will be classed at Lloyd's in the highest grade, and be fitted with engines of 130 horse-power, and every latest convenience. On leaving the stock she was christened the *Senior*, by Mrs. Lennard, of Middlesborough. She has been built to the order of Messrs. W. Ruys and Sons, Rotterdam, and is specially meant for the iron ore trade.

February 22nd, Messrs. Joseph L. Thompson and Sons launched from their ship building yard, North Sands, the screw-steamer *West Cumberland*. This vessel is about 1,800tons burthen, built under special survey to class 100 A 1 at Lloyd's, to the order of Messrs. Hine Brothers of Maryport. The engines are on the compound surface-condensing principle, of 130 horse-power nominal, by Mr. John Dickenson, of Palmer's Hill Engine Works. The *West Cumberland* will be fitted with four horizontal steam winches, Harfield s patent windlass, &c.

March 10th, Messrs. Turnbull and Son launched from Whitby, a new steam-ship, *Annie*, of the following dimensions;—Length, 270 feet 6 inches; breadth 34 feet 6 inches; depth 24 feet 6 inches; dead-weight capacity about 2,800 tons. The vessel has been built under special survey at Lloyd's for the 100 A 1 class, under the three-decked rule, and will be fitted with engines of 150 horse-power by Messrs. Blair and Co., Stockton-on-Tees, and has been built to the order of Messrs. James Gray and Co., of Whitby for the Atlantic and Indian trades.

The Pacific Steam Navigation Company have just added to their fleet two screw-steamers, the *Casma* and *Chala*, intended for employment in their West Coast service, and which have been constructed by Messrs. Laird Brothers, Birkenhead. These vessels are built entirely of steel manufactured at Landore Works, by the Siemens-Martin process, by the use of which, owing to its great tensile strength and excellent malleable quality, a lighter vessel is produced than if built of iron, while the strength of the structure is fully maintained. They are of 775 tons, built on a somewhat similar plan to the company's other West Coast ships, with awning deck and all cabin accommodation in deckhouses, and are designed principally for cattle and cargo, carrying merely a small number of passengers. The rig is that of a three-masted schooner, and their are fitted with direct acting inverted compound engines, working at 74 lb. pressure. The *Chala* made a trip Holyhead, on March 13th, and the results obtained were very satisfactory to all concerned. The engines developed about 500 horse-power by indicator, and the vessel attained a mean speed of full 10½ knots on the consumption of about 1¾ lb. per indicated horse-power per hour, the coals being carefully weighed on both runs. The same Company have launched from their yard the screw-steamer *Rhynland*, a sister ship to the *Belgenland*. She is intended for the Red Star Line trading between Antwerp and Philadelphia and will be fitted up for eighty cabin, eighty second-class, and 500 steerage passengere. She is 3,700 tons burden, having a length of 400 feet, with a breadth of 40 feet, and a depth of hold of 30 feet 6 inches. The *Belgenland* left Barrow, on March 12th for Antwerp, and will be forthwith put on her station.

The new ocean screw-steamer *Belgenland*, built by the Barrow Shipbuilding Company, for the Red Star Line, and intended to trade between Antwerp and Philadelphia, left Barrow Docks by the noon tide, for a forty-eight hours' trial at sea. This vessel is the first of the ocean steamers being built at Barrow for this company. Her dimensions are :—Length between perpendiculars, 400 feet; breadth, moulded, 40 feet; and depth of hold, 30 feet 6 inches; her gross tonnage being 3,692. She has accommodation for sixty saloon, sixty second-class, and 460 steerage passengers. Her engines are on the direct-acting, inverted-cylinder, surface-condensing principle, the high-pressure cylinder being 50 inches, and the low-pressure 90 inches in diameter. The stroke is 4 feet 6 inches, and the pressure of steam 80 lb. to the square inch. There are 6,922 square feet of heating surface in the boilers, and 290 square feet of bar surface. The engines are fitted up with many of the most modern improvements, and are started and reversed by automatic steam starting gear, which enables the engineer in charge to start and reverse the engines from full speed ahead to full speed astern within the fraction of a second. Rogers' patent exhauster is also fitted to the condenser. This forms a vacum of 12 inches to 14 inches before starting, thus rendering starting cocks unnecessary. The ship is fitted with steam steering gear, which works with promptness and with ease. The *Belgenland* procceeded from Barrow to the Calf of Man under easy steam, and thence by the west of the Isle of Man to Greenock, performing the distance between the Cumbrae and the Cloch lights at the rate of 11½ knots per hour, under easy steam. At Greenock the efficiency of the steam windlass was full displayed. In the return journey a speed was attained between the two lights of 13·3 knots per hour. The engines worked admirably, indicating nearly 2,000 horse-power, with only 55 lb. of steam; but this, of course, will be increased when the vessel was at her ordinary load draught, as then the propeller would be fully immersed. The engines performed 57½ revolutions, which is equally to a piston speed of 515 feet per minute. Her trial was in every way successful. She was built under the superintendence of Mr. J. Humphrys, manager of the Barrow Shipbuilding Company, and of Mr. Marshall, superintendent engineer of the Red Star Line.

A proposal has been made to organise a line of steamers between Baltimore and Barrow-in-Furness, for transporting live cattle from America to England. It is probable that two large ocean steamships will be built expressly for this trade. Baltimore possesses as good facilities for collecting and exporting cattle as Barrow possesses advantages for their importation and distribution throughout the country. The estimated capital required is £250,000, and the service is to be organised by Messrs. Price, Potter Walker, and Co.

SCOTCH.

February 24th Messrs. John Elder and Son launched from their works at Fairfield, an iron screw-steamer, *Princess Marie*, of 2,500 tons gross, and of the following dimensions :—Length between perpendiculars, 330 feet; breadth, 37 feet 9 inches; depth moulded, 28 feet 9 inches. This vessel has been constructed for the Stoomvaart Maatschappy Nederland, Amsterdam, and is intended for that company's service between Holland and Java, via the Suez Canal. The engines are upon their compound principle, with all the latest improvements, and are 400 horse-power nominal, with two cylinders, one 50 and the other 86 inches, stroke 3 feet 6 inches.

March 10th Messrs. John Elder and Co. launched from their shipbuilding yard at Fairfield, Glasgow, the *Arizona*, for the Guion Line, which is with, perhaps, one exception the largest vessel ever built on the Clyde. Her dimensions are as follows :—Length, 465 feet; breadth, 46 feet; depth, 37 feet; and tonnage 5,500 tons. The engines are compound inverted cylinder direct-acting screw engines of 1,200 horse-power nominal, to indicate 6,000 horse-power, made up of one cylinder of 62 inches and two of 90 inches the stroke of the pistons 5 feet 6 inches. Some idea of the immense dimeusions of the vessel may be gathered from the following details :—The dead weight of the cargo, exclusive of 1,200 tons of coal in the bunkers, is 2,600 tons, the cargo space is 167,000 cubic feet, and the load draught is 26 feet. The *Arizona* is built to accommodate 140 first-class, 64 second-class passengers, and 100 third class passengers or emigrants. The accommodation for the latter is on the main-deck. The vessel is fitted with everything that comfort and efficiency can suggest, and is quite in keeping with Messrs. Elder and Co's world-wide reputation. There are six double-ended and one single-ended boilers, the number of furnaces is 39, each 6 feet in length, and the working pressure is 90 lb. The new steel corvette Carysfort, the fifth of six being built for the Admiralty by Messrs. John Elder and Co., has left the Clyde, accompanied by H.M.S. Valorous and a navigating party, for Devonport. The Conquest, the sixth and last of the corvettes—which are built of steel, and have already being described in these columns—is also ready to depart.

We understand that Messrs. Donald Currie and Co., having decided to increase their fleet of mail steamers, have just contracted for the construction in Glasgow of two powerful steamships of 3,650 and 3,730 tons, under special survey, and beyond Lloyd's requirements for the highest class, One of these vessels, to be wholly of steel, will be built by Messrs. John Elder and Co., the builders of the Pacific Steam Company's vessels; and the other, to be of iron and partly of steel, by Messrs. Barclay, Curle and Co., the builders of the Walmer Castle and Taymouth Castle, of Messrs. Currie's Line. Messrs. Elder and Co. have just constructed six corvettes of steel for the Admiralty.

We have great pleasure in stating that Messrs. Napier, Shanks and Bell are about to start upon the first contract in their new shipbuilding yard at Yoker.

March 8th there was launched from Messrs. Dobie and Co.'s shipbuilding yard, Govan, a screw-steamer *Lydia*, of 1,450 tons measurement, built to the order of the Rhederer Company, of Hamburgh, for their China trade. The machinery of the *Lydia* is being supplied by Messrs. James Howden and Co., engineers, Glasgow, who had previously supplied the machinery for the sister ship *Electra*, launched by Messrs. Dobie and Co. in January last.

The steamer *Electra*, of 1,645 tons gross, and 260 feet by 33 feet 2 inches by 24 feet, of 160 horse-power and compound engines, had the official trial of her machinery on March 17. After being loaded to 17 feet draught, her speed was tested at the measured mile at Skelmorlie, when 10.81 knots were obtained with easy working, being 1.31 knots above the guaranteed speed. The consumption was afterwards tested over an extended run at 9½ knots speed, and found to be at the rate of 11 tons 7½ cwt. per 24 hours, this being 2 tons 2½ cwt. per day under the guaranteed consumption. The engines worked in the most admirable manner, and to the entire satisfaction of the representatives of the Owners, the Deutsche Dampfschiffs Rhederer, of Hamburg. The *Electra* proceeded direct to Hamburg on the termination of the trial.

March 8th there was launched from the Abercorn Shipbuilding Company's yard (Hanna, Donald and Wilson's) a screw-steamer *Marion*, of the following dimensions, viz., 90 feet by 19 feet 6 inches by 8 feet 6 inches; tonnage 158 B.M, The vessel was built to the order of the Whitecross Iron and Wire Company, Warrington, from specifications furnished by Mr. William Glover, C.E., Liverpool, and is specially built to take the ground with a full cargo of pig-iron on board. The vessel will be fitted with engines of 45 horse-power by Messrs. Dunsmuir and Jackson, engineers, Govan.

Feb. 22nd, the *Euphrates*, four-masted iron sailing barque, was launched from Messrs. H. Murray and Co.'s yard at Kingston, Port Glasgow. This clipper is a duplicate, as regards lines and rigging plan, of the *Benares*, owned by Messrs. Watson Brothers, of Glasgow, and by the same builders. Like the *Benares*, the Euphrates has been built under special survey of Lloyd's. Her dimensions are :—Length between perpendiculars, 260 feet ; breadth of beam, 39 feet ; depth of hold, 23 feet ; and she registers about 1,700 tons nett. Her bowsprit without entering the topgallant forecastle is securely bolted to the cutwater, and as a consequence the crew space, otherwise cramped, is exceedingly roomy, the petty officers and apprentices being comfortably housed on deck. The shrouds, instead of being made fast with lanyards and dead eyes, have screws, by which means the rigging may be speedily tightened or slackened at any moment. The lower masts have elevating tops and manholes into the holds for ventilation of cargo. So far she resembles the *Benares*, but, in addition, the *Euphrates* has her side-lamps permanently fixed, so as that in all weathers they can be easily trimmed from the deck. She is intended for the East Indian trade.

March 8th there was launched from the shipbuilding yard of Messrs. Blackwood and Gordon, Port Glasgow, an iron screw-steamer, *Hungarian*, of the following dimensions, viz., 260 by 35 by 18.9. This vessel has been built to the order of Messrs. Burrell and Son, of Glasgow, and is intended by them to form one of a line of direct steamers between Glasgow and the Hungarian port of Fiume. The upper deck is of iron, caulked water-tight, and covered with teak, which will insure flour and other fine cargoes being carried without the slightest danger of damage by sea water. Compound surface condensing engines of 160 horse-power nominal will be fitted on board, and it is expected she will be ready for work in about six weeks. She will also have steam steering and starting gear, furnished by Bow, M'Lauchlan and Co. The masts will be utilised as ventilators, while the timber heads can also be made use of in a similar way in fine weather, besides which she will have 18-inch ventilators in each hold. She has a double bottom, and will be able to carry 375 tons water ballast,

March 11th, Messrs. Russell and Co., Port Glasgow, launched into the wet dock a four masted ship, *Falls of Bruar*. She is a sister ship to the *Falls of Clyde*, lately built by the same builders, both being the order of Messrs. Wright and Breakenridge, Glasgow. The dimensions are : —Length, 260 feet ; breadth, 40 feet ; depth, 23 feet 6 inches. The tonnage is 1,740 tons net register, and she will carry 2,860 tons dead weight cargo. This vessel has been built to Lloyd's highest class, and is made to suit the timber trade, having four bow ports and four side ports. All her standing gear is set up with screws. She has donkey boiler and steam winch, is fitted with Napier's patent windlass, and has all the latest improvements.

The *Cuidad de Cadiz*, built by Messrs. Lobnitz, Coulborn and Co., of Renfrew, for Messrs. A. Lopez and Co.'s Mail Line between Cadiz and Havana, went on her official trial trip on the 17th March. Her dimensions are :—Length, 363 feet ; breadth, 38 feet ; depth, 32 feet 6 inches. She is built to the highest class at Lloyd's, and has accommodation for 200 first-class passengers, 54 second class, and 800 troops. The arrangements for ventilation are two patent blowers to give fresh air to troops. The vessel is also fitted with fire-hose and hydrants at short distances throughout her cabins, pneumatic bells, Perkin's patent steam baking oven, steam steering gear, Sir William Thomson's compasses, and patent boat-lowering apparatus. She is fitted with the builders' compound engines of 600 n. h.-p., which, on the trial trip, indicated 2,900, the cylinders being 57 inches and 102 inches diameter, with a stroke of 4 feet 6 inches. On the trial, which took place between the Cloch and Cumbrae Lights, the vessel being loaded to a mean draught of 19 feet, the engines worked smoothly and satisfactorily, and the vessel, in spite of a strong head wind, attained a speed of over 14½ knots, being much in excess of that guaranteed. This vessel is the largest of the Spanish Mercantile Marine, being 3,084 tons gross.

February 22nd, a new twin screw-steamer, the *Trident*, built and engined by W. Simons and Co., was launched complete from their works at Renfrew. It is the property of the London, Brighton and South-Coast Railway Company, and is intended to deposit concrete blocks of 100 tons through its bottom, which afterwards closes by its own buoyancy, and all its movements are controlled by two sets of independent engines. The *Trident* will act as a consort to the steamer *Neptune*, recently built by this firm, and both are intended for the formation of the New Channel Harbour, Newhaven.

March 11th, Messrs. H. M'Intyre and Co. launched from their shipbuilding yard at Paisley the *San Jose*, an iron screw-steamer of 1,000 tons. The *San Jose* is classed 100 A 1 at Lloyd's and is a sister ship to the *Navidad*, launched by the same builders in February. She will be fitted with compound surface-condensing engines, by Messrs. William King and Co., Glasgow.

February 28th, the trial trip of the screw-steamer *Navidad* took place. The *Navidad* is an iron screw-steamer of 1,000 tons, lately built by Messrs. H. M'Intyre and Co., Paisley, for the Compagnie Hispano Francaise, for the trade between France and Spain. She is fitted with compound surface-condensing engines by Messrs. Wm. King and Co., Glasgow. The speed atained was 11 knots per hour, which was considered highly satisfactory.

March 8th, there was launched from the Abercorn Shipbuilding Company's yard, Messrs. Nanna, Donald, and Wilson's, a substantially built screw-steamer of the following dimensions, viz., 90 feet by 19 feet 6 in. by 8 feet 6 in. ; tonnage, 158 B.M. She is built to the order of the Whitecross Wire and Iron Company, Warrington, from specifications furnished by Mr. W. Glover, C.E., Liverpool. The vessel is specially built to take the ground with a full cargo of pig iron on board. The engineers are Messrs. Dunmuir and Jackson, Govan, who will supply engines of 45 horse-power.

February 22nd, there was launched from the boatbuilding yard of Messrs. Scott and Macgill, Bowling, an iron screw-steamer, *Bute*, of the following dimensions :—Length, 100 feet ; breadth, 19 feet ; depth of hold, 9 feet ; and about 170 tons burthen. She has been built to the order of Messrs. Hill and Co., Glasgow. The *Bute* is a sister ship to the screw-steamer *Success*, although much larger in size, and will be engaged in the same trade, and is intended to be put on for the purpose of giving greater carrying facilities for goods between Glasgow, Rothesay, Largs, Millport and Arran.

February 22nd, Messrs. John Key and Sons, engineers and shipbuilders, Kirkcaldy, launched from their building yard, Abden, Kirkcaldy, a new screw-steamer, *Joseph Rickett*, of the following dimensions :—Length between perpendiculars, 185 feet ; beam, 28 feet 2 inches ; depth of hold, 14 feet ; tonnage, gross 700, net 450. Has compound engines, with cylinders 24 and 46 inches diameter by 33 inches stroke, and to work at 80 lb: pressure. Is built expressly for the coal trade between London and Sunderland.

March 6th, there was launched from the yard of Messrs. Gourlay Bros, and Co., Camperdown Ship yard, Dundee, an iron screw-steamer, the *Lapwing*. She is built to the order of the General Steam Navigation Company of London, and is of the following dimensions : Length, 236 feet ; breadth, 32 feet ; depth in hold, 18 feet, and is about 1,225 tons gross register. She will be fitted by the same firm with engines of 160 nominal horse-power, and has accommodation for first and second-class passengers, also for horses and cattle, and will be engaged in the London and Continental trade.

NOTES AND NOVELTIES.

THE DEPTHS OF THE OCEANS.—The untrustworthiness of the varying estimates given in text books for the mean depths of the oceans has induced Dr. Otto Krümmel to make a new and thoroughly careful calculation of the mean depths of the various ocean beds. The result of his calculations Herr Krümmel states as follows in a note to the Göttinger Academy :—1, Atlantic Ocean, mean depth in fathoms, 2013 area in square miles, 29,514,275 ; 2, Indian Ocean, 1829, 28,369,595 ; 3, Pacific Ocean, 3887, 60,343,690 ; 4, South Ice Sea, 1800 (?), 7,930,000 (?) ; 5, North Ice Sea, 845, 5,264,600 ; 6, Australasian Archipelago, 487, 3,046,600 ; 7, Mexican Gulf, 1001, 1,765,910 ; 8, Mediterranean Sea, 729, 1,109,230 ; 9, Baltic Sea, 36, 159,690 ; 10, Red Sea, 243, 170,820 ; 11, Persian Gulf, 20, 90,100 ; 12, North Sea, 48, 210,505 ; 13, the Channel, &c., 47, 78,416 ; 14, Gulf of St. Lawrence, 160, 101,075 ; 15, East Chinese Sea, 66, 472,210 ; 16, Japan Sea, 1200, 383,205 ; 17, Okhotsk Sea, 830, 553,080 ; 18, Behring Sea, 550, 864,555 ; the three open oceans (1-3), 2026, 118,227,560 ; the Mediterranean seas (5-11), 740, 11,606,950 ; the coast seas (12-18), 386, 2,663,046 ; the entire ocean (1-18), 1877 fathoms, 140,427,556 square miles. It thus appears that the mean depth of the great ocean which everywhere surrounds the land is 1877 fathoms, or 11,562ft., or about 2⅛ miles. Herr Krümmel remarks that he has apparently taken the total surface at 3,276,000 square miles too little, a result of the rough methods of measuring the areas which he was compelled to use. In his further calculations, therefore, he takes the ocean area at, in round numbers, 143,703,000 square miles, and thus finds that the present proportion of land and water is as 1 to 2·75. Comparing with the mean ocean depths the mean height of the continents above sea-level, he finds that the mean height of the land as a whole is 1377ft., which is only about one-eighth the mean depth of the ocean. Herr Krümmel enters into a calculation as to the relative volumes of the water and the land above the ocean belt ; in this respect the proportion of land and water is as 1 to 22·4. On the other hand, the masses—volume multiplied by specific weight—of earth and ocean are very nearly the same.

ANCHORS OF BESSEMER STEEL.—It is stated that the Admiralty have decided to adopt the use of anchors made of Bessemer steel, which can be had at less than one-half of the price paid for the costly "best" iron hitherto used; but it yet remains to be seen how far the quality will be the same. This extension of the area in which Bessemer steel is now used is likely to be of great value to the steel-makers, if the experiment prove successful, and to have important effects on the chain and anchor trades.

Prevention of Scale in Boilers.—The following is a recipe for the preparation of a coating for the inner surface of boilers to prevent the formation of scale: Gradually dissolve 6 pounds of a mixture of 25 parts of colophonium, 2½ parts of graphite, and 2½ parts of lampblack, in 40 pounds of boiling gas tar, adding about one pound of tallow. The solution is diluted with about 50 per cent. of the petroleum, and applied in a warm state. It has a pungent smell, and should be put on rapidly, the precaution of using closed lanterns being necessary. Its effect is to cause the scale to come off in large flakes when picked.

Life-Preserving Bulwarks.—At a recent meeting of the Manchester Mechanical Society, Mr. Gadd proposed to form the upper portion of the bulwarks of ships of loose sections composed chiefly of hollow thin metallic tubes divided into compartments by diaphragms, the sections to be about 12ft. long, each to be divided into a number of compartments of any suitable form, and provided with projections on their under sides, so as to be fitted on to the place of the top rail of the bulwarks, and to be a substitute therefore. These sections, when immersed in the water, would form so many pontoons, and would be provided with cords and loops along their sides, and in the event of the ship going down, would be lifted out of their place by the action of the water. He would also construct the whole of the seats on the deck in the same manner, and underneath every seat, and along the entire length of the bulwarks and lying on the deck, other floating tubes could be provided. In the case of sea-going vessels, he would fit the bulwark tubes with holes, rings, or slots, so that in case of foundering, they could be joined together either before or after taking to the water. The great advantage of this arrangement would be that it would be in perpetual readiness for any sudden emergency, and there would be no doubt that vessels could be readily fitted in this manner.

Sound Danger Signals.—A new method of giving signals of warning at sea that has recently been perfected, and is now employed with success at one of the most dangerous points on the coast of Bretagne. The signals consist of sounds, which are repeated at short intervals, and can be heard, even against the wind, at a distance of six kilometres. The apparatus by which these sounds are produced is self-acting and very simple. It consists of a hollow cylinder, a few centimetres in diameter, and three or four metres long, closed at the lower end, and secured by an anchor to the bottom of the sea. In this cylinder is a pump which sucks in the air, compresses it, and sends it out through a whistle, and this pump is worked by a huge faggot, floating on the surface of the sea, and whose movements, rising and falling with the waves, furnish the sufficient force.

Scale in Marine Boilers.—Mr. Harris, chief engineer of the Milford and Weymouth Mail Boats belonging to the Great Western Railway Company, has, we are informed, a patent for the prevention of the deposits of scale, so injurious to marine boilers, which so greatly impairs their efficiency and is a source of trouble to those in charge. Prepared in suitably shaped blocks, under Mr. Harris's patent, zinc is found a most efficient means of preventing these deposits. By its use all further corrosion is stayed, whilst the scale previously formed is reduced to a substance as fine as flour and somewhat resembling brickdust. This powder can easily be swept out from the boiler. In the R.M.S. Packet "Waterford," a few of these blocks entirely dispensed with the use of all chipping and scaling tools and the boiler was left in quite a clean condition. The dust, though not pleasant, is endured on account of the shortness of the operation, and the labour saved in chipping and scaling. We shall return to this invention in a future number.

Smith's Patent Stockless Anchor.—The advantages claimed for Smith's anchor over those hitherto in use may be briefly stated as follows:—The stock being dispensed with the anchor can therefore be carried 20 per cent. lighter than others according to Board of Trade and Lloyd's rules. All danger of fouling cable is obviated, as nothing projects above the ground when the anchor is holding. Greater holding power is obtained, as both arms or flukes are buried in the ground at once. Greater facility in working, and snug stowage, the anchor lying flat on the deck. Many vessels at present building have Smith's anchors entered in their specifications, and among some of those lately launched we may mention the steel sailing ship *Bay of Cadiz*, the steamers *Adela*, *Azalea*, *Anglian*, *Ada*, *Avon*, *Columba* (steel), *Constantine*, *Cedar*, *Caroline*, *Cindad de Cadiz*, *Devon*, *Dotterel*, *Dunmore*, *Deva*, H.M.S. *Garnet*, &c. Anchors manufactuaed on Smith's patent are made in various patterns specially suitable for men-of-war, merchantmen, dredgers or yachts, and the agents, Messrs. Gilbert, Bogle & Co., Glasgow, have at present many orders in hand including two anchors weighing upwards of 3½tons each for the Cunard Company's new moorings in the Mersey. Smith's anchors are made of the best scrap iron without welding, and have stood a strain of 75 per cent. over Admiralty proof without deflection.

Metallic Packing.—A new form of packing is described by Herr J. Strieder, of Elberfeld, He uses tubes of lead or some soft metallic alloy, filled with hemp, cotton, or other suitable vegetable material. These tubes can be prepared of great length and cut to fit any given requirement. The ends may be either soldered together or forced into close contact. The evident convenience and cheapness of this packing are especial recommendations, to which durability may be added if the tubes are made of the right alloy.

The Testing of Boiler Plates in the United States.—The American Board of Supervising Inspectors of Steamboats has issued a circular, calling attention to the recent changes in the regulations concerning, among other things, the testing of samples of boiler plate. The new rules require the taking of only one test specimen from each sheet, instead of two as formerly, the area of the test piece to be one-quarter of a square inch for all iron under five-sixteenths of an inch in thickness, and on all iron over five-sixteenths of an inch in thickness the area is to be the square of the thickness. Samples may be tested upon the Riehle, Fairbanks, or any other reliable testing machine, instead of upon the first-named only, as was the case in the old rule. To ascertain the ductility of the iron it is required that the fractured area of iron, of under 45,000 lbs. tensile strength, shall show a contraction of area of 12 per cent.; 45,000 lb. and under 50,000 lb., should show 15 per cent.; 50,000 lb. tensile strength and over should show 25 per cent. The shape of test specimen given in the old rules is retained in the new, viz., 8in. in length and 2in. in width, with semicircular grooves cut out in the middle. Notwithstanding that this form of test piece has, according to the American *Manufacturer*, repeatedly been shown by all recent authorities on the testing of metals to give an erroneous result in the test, making the iron have an apparent strength from 5 to 30 per cent. greater than the real strength. Why the Treasury Department still allow this incorrect shape of specimen is inconceivable.

Life-saving Projectile.—The Massachusetts Humane Society has lately adopted and presented to the Royal National Lifeboat Institution a new projectile to be fired from a light gun for saving life at wrecks. Under the auspices of the Board of Trade, a series of experiments were made at Shoeburyness, by the War-office authorities, to prove the value of the invention. Two brass guns, weighing 56 lbs and 69 lbs respectively, each 2 feet in length, were used to fire the projectile, the charge of powder varying from 3½ to 4½ ounces. The projectile weighed, when filled ready for firing, 12½ lbs. It is an elongated shell carrying a line tightly coiled within, which it pays out as it travels through the air. It is put into the gun, as it were, the wrong or conical end first, and, leaving the muzzle, at once reverses, the front end becoming the rear end, and maintaining, due to four wings, on the principle of the arrow, an accurate and distinct range, with none of the wobbling and singing and consequent loss of power so common to shot fired from existing rifled ordnance. In make up, the projectile is a tin tube 20 inches long, 3¼ inches diameter, having wings at one end and a leaden shot weighing 6lbs at the other. Within the tube is a compact coil of line 17½inches long and the diameter of the tube. This line is from 200 to 400 yards in length, with a breaking strain of from 203 lbs to 400 lbs. The shot is attached to a second or short coil lying alongside the gun, so arranged that on the shock of the discharge the line runs freely from both coils. The experiments were conducted by Captain White, R.A., assisted by the inventor, Mr. E. S. Hunt, of Boston. At Mr. Hunt's range, 22½ deg., an elevation which he has found by continued practice best suited to surely throw the line over any wreck with the smallest strain to it and the projectile, the distances obtained and measured on the official range course were 389, 448, and 507; the deviation of the shot and line from the target being 4 2-5ths, 9, and 8 yards respectively. Three shots fired at 30 deg. and 35 deg. elevation, traversing a line of flight some 400 feet in the air, ranged 478, 489, and 386 yards, with deviations of the shot and line from target of 2, 6, and 6 yards respectively.

Perroy's French Ships Distilling Appratus.—The water it furnishes is fresh, aerated, inodorous, limpid and quite potable. The apparatus has three principal parts, an aerator, a refrigerator and a case of animal charcoal. In the first, the steam passes through two cones, the second enclosing the first, and air is drawn in through the second, so that the steam is condensed in an air current, and gives well aerated water. The refrigerator is of a circulatory type—a number of tubes connected so as to be easily taken apart for cleaning and enclosed in a case through which sea-water circulates (entering below, and leaving, in a heated state, above) with cooling effect. The water is then caused to circulate in the case of animal charcoal. M. Perroy adopts three types of his apparatus, differing only in size. The largest produces 10,000 litres of water in twenty-four hours, the second 6,000, the third 3,500. The system was first tried on board the French frigate *La Gloire*, and it has been generally adopted, where required, in the French Navy.

The Russian Navy.—The Government seems to be very busy as regards the construction of new ships. In Petersburg, at the new Admiralty three gun boats are in the course of erection. These vessels will be of the type of the boat Torsh, viz., 97 feet long and 28 feet 6 inches in breadth; the draught will be 6 feet 8 inches. The armament consists of one 11 inch steel gun placed on elevated platforms and two 4 pounders, also guns of steel mounted on ordinary carriages. The boats will have double screws and the engines are expected to have a power of 240 indicated horse. New orders for a set of three boats of the same type are expected in December. The second torpedo boat, *Sultanka*, constructed by the firm Bellino-Feindrich, was lately been launched at Odessa; the trial showed it to have a speed of 15 knots, the Government regulations require not less than 14 knots.

A Fast Torpedo Boat.—A trial has taken place at Long Reach of first-class torpedo boat recently constructed by Messrs. Yarrow and Co., for the Admiralty. Three runs were made with the tide and three against it in the usual way, with the following results:

	Time.			Knots per		
Runs.	m.	s.		Hour		Knots.
1	2	37	=	22.93	Mean of 1st pair	21.35
2	3	2	=	19.78		
3	2	33	=	23.53	Mean of 2nd pair	22.05
4	2	55	=	20.57		
5	2	30	=	24.00	Mean of 3rd pair	22.23
6	2	56	=	20.45		

Mean of means calculated by the Admiralty method 21.93 knots. The load carried during this trial was 6¾ tons, which represents the weight of torpedoes, gear, coals, &c. The steam pressure was 124 lb. throughout, and during the four first runs the engines were slightly linked up, which accounts for the last pair of runs giving the best result. It was found that at speeds of between 17 and 19 knots the vibration of the boat was considerable, but when running over 20 knots it entirely disappeared, so much so, in fact, that it was quite possible to write legibly on the stern immediately over the screw. It is interesting to note that this craft is precisely the same in dimensions, scantling, and displacement to those already built for the English Government, which on the trial have given speeds varying from 18 to 19 knots.

Trial of an Ice Yacht on Dun's Dish.—The Brechin correspondent of a contemporary describes the trial of an ice yacht on Dun's Dish, a sheet of water situated between Brechin and Montrose. He says: A few adventurous spirits having heard of ice boats in America, constructed a craft 10 feet in length, triangular in shape, three skates or runners, one of which acts as a helm. Masts, jib, and sail, each about 12 feet in length, were procured from an experienced maker in Dundee. Saturday last, the 1st March, was the first favourable day, and our sailors betook themselves to Dun's Dish with their novel craft. The little lake was frozen from end to end, and there was a steady breeze blowing from the west. Five minutes sufficed to put everything into ship shape, two of the party went aboard, and as she left the shore she was greeted with cheers, and christened the Ice Queen. For several hours the party sailed over the lake by turns. The ice unfortunately was rather rough in some places, so that with two persons on board no great speed was attained, but with one the speed at times was extraordinory—not less than 30 knots. The sensation of skimming along the surface at such a rate is most pleasant as well as exciting. There is no danger whatever (if the ice is strong enough) as the vessel obeys the helm instantly, and thus can be made to tack as well as a first-class yacht. In short the experiment was a thorough success.

THE ANNUAL REPORT OF THE PHOSPHOR BRONZE COMPANY.

THE annual report of this company for 1878, says that during the first half of the year the business done was exceptionally large, owing in a great measure to extensive Government orders. The second half year's trading, although by no means equal to that of its immediate predecessor, compares favourably with former periods, and this result is most gratifying when it is borne in mind that the utmost depression has prevailed and still exists in the engineering and manufacturing world, and more particularly in the iron and coal producing districts. The increase of orders from abroad has counterbalanced the paucity of business in this country. The directors have been able to pay off the debentures which became due on 10th May, 1878, and also to invest a small sum in a general metal foundry, a going concern, which bids fair to make a good return, and be of considerable benefit to this company. An interim dividend of 2½ per cent. for the half-year ending 30th June, 1878, has already been paid, and the directors recommend a further dividend sufficient to make the distribution for the past year equivalent to 10 per cent., free of income tax, on the paid-up capital, leaving a fair sum to be carried forward.

Recent Applications for PATENTS connected with MARINE ENGINEERING, SHIP CONSTRUCTION and MECHANICAL APPLIANCES for use in SHIPS.

Fuel Supplier, Johnston and Vaughan, 659.
Light for Signal Lamps, J. Tabrar, 741.
Mariner's Compass, Sir W. Thomson, 679.
Marine Engine Telegraphic Apparatus, J. Shaw, 652.
Packings for Piston Rods, J. W. Preston, 734.
Piston Packing Rings, J. Pickering, 691.
Plummer Blocks, B. Hewitt, 655.
Ship's Berths, W. R. Lake, 650.
Spring Piston Ring, R. H. Ellacott, 669.
Steam Boiler Feeding, J. Haddan, 701.
Submerged Vessels, Removing water from, J. Pullar, 710.
Towing Vessels, F. W. Scott, 678.
Valves and Piston Rods, G. Kingsdon, 746.
Water and Steam Supply Regulator, F. W. Durham, 651.
Winches, T. Archer, Jun., 651.
Motive Power, E. H. Leveaux, 796.
Motive Power Engines, H. Davey, 814,
Meters, H. J. Haddan, 757.
Packing for Joints, Henwood and Chapman, 795.]
Propulsion of Boats, W. R. Lake, 773.
Screw Propellers, T. Skinner, 782.
Checking Hawsers, N. Bullivant, 914.
Feed Apparatus, A. Thomson, 851.
Governors, E. A. Bourry, 901.
Governors, R. Schmitz-Werotte, 903.
Lubricating Packing, F. Chapman, 940.
Propelling Vessels, D. H. Sisson, 910.
Speed Governors, Bailey and Allcock, 875.
Steam Engines, D. Joy, 929.
Steering Gear, Bradley and Latham, 922.
Floating Naval Arsenals, Docks, etc., Vogt & Figge, 993.
Fog Signal Compass, W. Hughes, 996.
Hose for Water, Pavoux, 998.
Lubricators, E. Meanock, 995.
Portable Boats, G. R. Shareman, 972.
Preventing Incrustation, H. Haymen, 959.
Propelling Vessels, A. Morton, 977.
Ships, E. Smith, 1034.
Steam Pumping Engines, W. Morgan-Brown, 952.
Steering Apparatus, G. Guthrie, 994.
Steering Gear, A. Anderson, 1031.
Steam Steering Gear, T. E. Bingham, 1013.

⁂ [As the foregoing list contains "applications" for Patents only, the specifications are not accessible to the public but information respecting some of them and as to any other patents in progress or completed may be obtained by addressing a note to the Editor at the office of this paper.]

NOTICES.

ALL Contributions and Books for Review, should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessary for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

All Advertisements and Business Communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed.

Marine Engineering News,

LONDON, MAY 1, 1879.

IN the field of Marine Engineering and Shipbuilding, the great event of the bygone month was the annual meeting of the Institution of Naval Architects. On these occasions the gathering always includes the most eminent among our naval architects and craftsmen, and the papers read and discussed are always noteworthy. The conference this year was second to no previous one in either respect; and although the weightiest essays related to naval armament more than to naval architecture, and had a somewhat disproportionate relation to the fighting as compared with the commercial marine, it must not be forgotten that the results of expensive experiments and of ingenious design, as applied to the fleet, are often of the highest importance to the constructors of the commercial navy. Admiral Robinson, in a very able paper, in which he gave a resumé of the history of armour-plating, advocated Mr. Hughes' system of an iron plate of one thickness supported throughout its back by hollow rolled iron strings filled with wood. Mr. Barnaby, on a kindred subject, indicated that constructors are now going in the direction of confining armour to the more vital parts of the ship, and he showed from the recent experiments at Portsmouth how effectively the ship's coal may be used as a protection from shot. In the account of the structure and arrangements of the new steel corvette IRIS, and in that of its official trials, which had a most unexpected result, there was much that our shipbuilders and marine engineers will find of service in their work. Mr. Milton's paper on "Strains in Crank Shafts," which will be found in our present number, will also be of great practical use. Mr. Humphrey's method of mechanical shipbuilding seems a new departure in the business of the naval constructor; and Mr. Scott Russell's able and perspicuous discourse on his famous discovery of the true nature of the wave of translation will be long remembered by those who listened to it.

However important to agriculturists a foreknowledge of atmospheric changes may be, it is much more so to those who plough the deep. The advance of any science is invariably accompanied by economical applications of it, devised by those who are ever on the watch to add invention to discovery. Metéorology has of late years made considerable progress; and, assisted by the electric telegraph, the more accurate and intimate knowledge that has been acquired of atmospheric currents has been utilized to a great extent in the forecasting of storms, and many valuable lives and much property have been thereby saved from the ravenous deep. From local circumstances these predictions have been more frequently verified on the North American continent than on this side of the Atlantic; but it appears that most of our great circular storms are incubated there, and of late "Old Probability" has given us in England timely and often useful warning of atmospheric disturbances on their way. Of late our own Meteorological Office has been each evening issuing daily forecasts for the coming day, and these have been found remarkably accurate. If they continue so they will prove a great boon to the farmer in this changeable climate; their importance to seafaring men, whether sailors or fishermen, need not be enlarged upon.

One of the wisest, if not the most honest and successful of English statesmen thus expressively defined our first line of defence: "The sea is our barrier, ships are our fortresses, and the mariners that trade and commerce alone can furnish, are the garrisons to defend them." The Spanish Armada was driven off by a hornet's nest of merchantmen, beneath comparison as regards tonnage with our present mercantile marine; and now it seems that the swift modern commercial steamships need not fear to confront the leviathan ironclads of these latter days. Mr. Barnaby at the Naval Architects' meeting referred to above, speaking of the Portsmouth experiments, stated that no amount of resistance which an armour plate could show would give the satisfaction he received from the excellent behaviour of the simple combination of coal and thin loose iron sheets; so that in our mercantile marine we may have a second line of defence corresponding to that which the Volunteer force supplies to the regular army, and consisting of upwards of four hundred steamers between twelve hundred and five thousand tons register, very many of them combining high speed with large coal-carrying capacity. It is satisfactory to find that this new arm of defence, for calling and impressing attention to which credit is due to Mr. Brassey, is receiving the careful consideration of the Admiralty.

Steel is undoubtedly the shipbuilding material of the future. It is therefore gratifying to find that a problem which has engaged the attention of metallurgists for the last fourteen or fifteen years has been solved by a process which by completing the Bessemer method, makes the conversion of the most impure ore into steel commercially possible. Heretofore, the Bessemer process has proved incapable of eliminating the phosphorus which occurs in all samples of iron except those smelted from the purest ores; and the effect of the new process, the basis of which is the employment of magnesian limestone as a flux, will render good steel cheap enough to allow of its being used wherever it is more advantageous than iron, at a very little increase of cost.

There is a legend, dating from the most ancient times, which relates that a large, populous and civilized island was suddenly overwhelmed by the waters of the Atlantic,—the island of Atlantis, from which the ocean that rolls between Europe and America derives its name. And although the truth of the tradition in question has been denied by modern savans, there is no doubt that large insular tracts have disappeared in the German Ocean even in comparatively recent times, gnawed away by the restless waves as Heligoland is being at the present day. At a late meeting of the Royal Dublin Society, an old map of about the date of 1640 was exhibited, which shows an island on the western coast of Ireland, nearly at the spot now occupied by the Porcupine Bank, and named Brazil. The small rock which marks the fishing ground of Rockhall, off the west coast of Scotland, is represented in the same map as two small islands. In this case, if not in the others, it is probable that depressions in the sea bed by volcanic action may have been, to some extent, the cause of the catastrophe.

Two recently invented instruments for taking soundings at sea, while exhibiting great skill and ingenuity in their inventors, will materially add to the safety both of ships and seamen. One of them is Dr. Siemens' Bathometer. It is constructed with reference to the fact that the total gravitation of the earth diminishes in passing over the surface of the ocean in the exact proportion of the depth of the sea to the radius of the earth. By its means the captain sitting in his cabin can tell to a nearness the average depth of the waters over which he is sailing, as easily as he can tell the pressure of the atmosphere by his barometer; and by a reference to his charts he may also learn his position when no direct observation can be made. The other instrument is founded on chemical science, and by it Sir William Thomson enables the navigator to obtain accurate soundings from a ship running at full speed in water of a depth not exceeding 100 fathoms. When the sinker reaches the ground, no matter what length of line may have been payed out, the alteration of colour in a tube lined with chromate of silver shows how far the pressure of the superincumbent water has forced up the water in the tube. With these two instruments, either in the open ocean or off the more dangerous shore, the seaman may now proceed on his voyage with the utmost confidence.

THE STEAM TRIALS OF H.M.S. IRIS.*

BY MR. J. WRIGHT, VICE-PRESIDENT.

IN the paper on the comparative efficiency of twin screw propellers in deep draught ships, read by Mr. White at last year's meeting of the Institution, some particulars were given of the first trials of H.M. despatch vessel *Iris*, and in the discussion which followed, a promise was given to communicate to the Institution the results of some further trials intended to be made with her new screw propellers of modified forms and dimensions. I now propose to redeem that promise, so far as I am able to do so. The trials were not so complete and extensive as it was then hoped that they would have been, for the recasting of the original screw blades and the construction of a pair of new two-bladed screws occupied a considerable length of time, and as the ship had to be completed ready for service by a given date, the proposed series of trials had to be curtailed. However, the results of the trials which were made are interesting and instructive, and will, it is hoped, assist somewhat in throwing light on the hitherto little investigated subject, the application of twin screws to fast steam ships.

The first official trial, made on the 14th December, 1877, was what is known as the contractor' trial, of six hours' duration, at full power, at sea, to test the efficiency of the machinery generally. The following are the particulars of this trial :—

Draught of water	forward	15ft. 8in.
	aft	20ft. 7in
Area of midship section		702 sq. ft.
Displacement		3300 tons.
Mean pressure in cylinders	high	41·5 lb.
	low	11·9 lb.
Average revolutions per minute		90·318
Average indicated horse-power		7060
Speed of ship, about		16·4 knots.

On this trial, and on a preliminary trial made just before, it was seen that the speed of the ship was about a knot an hour below what was expected by her designer, the Director of Naval Construction, estimate of the speed was confirmed by the result obtained in Mr. Froude's experiments with her model, and it was determined as had been done from time to time before, to make several series o progressive measured mile trials, to ascertain her performance correctly, and from the results to try and find out the cause of the defficiency of speed. I can testify, from personal attendence at the trials, that they were all most carefully made by the experienced officers at Portsmouth, but you will, perhaps, find in analysing the results of the trials at the lowest speed, that in spite of all the care taken some discrepancies appear. These probably have arisen from the difficulty of obtaining the indicated horse-power with sufficient accuracy, and from some variation in the amount of the friction of the engines, on the several days of the trials. The two pairs of engines have eight cylinders, four high and four low-pressure; at low powers the indicated pressures are very small, and the increments of error which may arise from the friction of the indicators and the measurements of the diagrams, where the top and bottom lines are very close togetger, will tell much more than at the higher powers.

The hull of the *Iris*, as you are aware, is of Landore Steel, and the bottom was coated with Sim's composition. The state of the hull, both above and below water, was, as nearly as possible the same on all the measured mile trials, and they were all made at about the same draught of water, viz., 15ft. 8in. forward, and 20ft. 6in. aft Fortunately also the force of the wind and the state of the sea were so nearly similar on the days of the trials that these influences on speed may be left out of account in considering the results of the trials. At the above draught of water the midship section of 700 square feet; the displacement 3290 tons; and the wetted surface, 18600 square feet. The original screws of the *Iris* were four-bladed, diameter, 18ft. 6½in.; the pitch at the leading edge was 17ft. 2in., at the after edge 19ft. 2in., and the mean pitch, as measured, 18ft. 2in. The disc area of the blades is about the usual portion for four-bladed screws, viz.; three-tenths of the whole disc. The type of screw had given very good results in a number of single-screw ships, and notably in the *Himalaya* where it give the best results of any she has had during her long career. The case of the *Iris* shows, however, that a propeller which has proved very efficient for a single-screw ship may not be well suited for a twin-screw ship. You will observe that the highest speed obtained with 7503 indicated horse-power was only 16·577 knots, or about a knot below what was expected. The screws will be referred to as No. 1. The second series of progressive trials was made with the same screws, with two of the blades of each removed but no alteration was made in the pitch of the blades left in place. This was considered to be the simplest and readiest method of proving, as was supposed, that the blade area of the screws with four blades was largely in excess. It was not considered desirable to put a very high power on these two-bladed screws, or to run the engines at more than about 90 revolutions, and, consequently, the highest indicated horse-power developed was 4361, with 88·89 revolutions, and the speed obtained was 15.726 knots. Although this series of trials proved that the blade area of No. 1 screws was much too large, it could not be accepted as proving that two-bladed screws were better than four-bladed, and it was desired to retain four blades for the working screws, on account of the less vibration, and the greater uniformity of action to be obtained in rough weather, the original blades was recast by Messrs. Maudslay, and made to the form and dimensions shown in Diagrams 1 and 2. The reduced diameter is 16ft 3½in., or 2ft. 3in. less than before, but, as will be seen, on comparing the forms of the old and new blades, the effective diameter is reduced in a rather larger ratio than the actual diameter. The pitch at the forward edge of the blades is 18ft. 11½in., at the after edge 20ft. 11½in., or an increase of 1ft. 9½in. on the No. 1 screws. The disc area of the blades is ·288 of the whole disc. The blades are curved aft a little towards the tips, with the view of keeping the points rather further away from the a brackets, and of checking, in some degree, any centrifugal tendency of the water acted on. The blades were polished on both sides to reduce friction, and the edges were made sharp. The original bosses to which the new blades were attached had each a conical tail-piece added. These screws will be referred to as No. 3. This shows an improvement on No. 2 screws with two blades, and, as compared with No. 1 screws, an increase at full speed of two knots, with only 211 indicated horse-power more. The maximum speed was 18·57 knots, or about a knot more than the original estimated speed. The vibration was very moderate considering the large amount of power put through the screws, and the fineness of the stern of the ship. As the full power of the engines could not be exerted on the No. 2 screws with two blades, a pair of full strength two-bladed screws (3) of the well-known Griffiths shape were made. The blades were polished on both sides, like those of No. 3 screws, and the edges were made sharp; the boss was spherical, and had a conical tail-piece. The diameter is 18ft. 1½in., the pitch at the leading edge 20ft. 3¼in., at the after edge 22ft. 3¼in. The disc area of the blades is ·19 of the whole disc. These screws will be referred to as No. 4. The highest speed given by these screws was 18·587 knots, with 7556 indicated horse-power. The vibration set up in the vessel with these screws in use was greater at all speeds than with either of the four-bladed screws. At the 12½ knot speed the vibration was very moderate, but it increased greatly up to the 15¾ knots speed, and from this it decreased again the maximum speed of 18½ knots was reached, when it was nothing unusual. After the series of trials was made it was determined to retain the No. 3 screws for use on the vessel, although their performance on the measured mile was not quite so good. It was intended to reduce the diameter and increase the pitch of No. 3 and No 4 screws, and try them again, but time did not permit of this being done. The mean pitch at which this screw was set was determined by the revolutions the engines were required to make them develope at least the specified indicated horse-power, 7000. The engines being compound, it was necessary to run them at fully ninety revolutions to get them to take enough steam of 60 lb. pressure to produce the specified power. You will observe that the blades of all screws were made with a small increase of pitch, 2ft. on the width of the blade, with the view of diminishing shock at the leading edge. All the screws were made of gun metal, as usual in the Navy.

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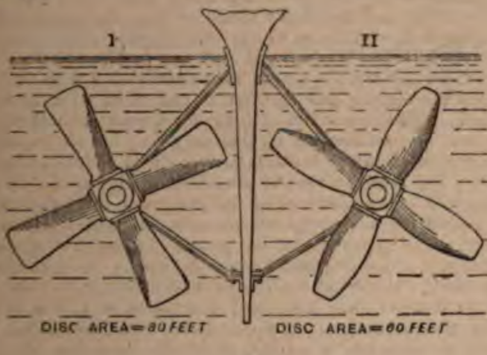
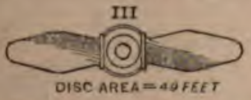
* Read at the Institution of Naval Architects.





It had been suggested that the engines of the *Iris*, having four high and four low-pressure cylinders with the accompanying large number of moving parts, might absorb more power than usual in dead load friction. In order to test this by actual trials, the screw shafting was disconnected at the first coupling, and the engines run at various speeds from eighteen up to ninety revolutions per minute At the low speeds the top and bottom lines of the indicator diagrams, taken with the weakest springs available at the time, were so close together that the mean pressure could not be obtained with sufficient accuracy to warrant me in giving the results as reliable. At the highest speeds, however, I believe the diagrams may be taken as fairly trustworthy. Each set of engines was kept running steadily while two sets of diagrams were taken. The port engines running at 87·5 revolutions per minute gave 202 indicated horse-power, and the starboard engines at 90·5 revolutions gave 196 indicated horse-power, or together 398 horse-power, in dead load friction. The trials at all speeds showed that the starboard engines worked with the least friction. On sheet 7 are given the indicated thrust curves for the measured mile trials with several screws, viz., with No. 1 in black, No. 2 in dotted black, No. 3 in red, and No. 4 in green. The indicated thrusts have been calculated by $\dfrac{\text{I.H.P.} \times 33{,}000}{\text{mean pitch of screw} \times \text{revolutions}} = \text{thrust}$. The base line shows the speed in knots and the ordinates the thrusts in tons. The curves have been completed in the manner devised by Mr. Froude, and it will be seen that the curve for No. 1 screws shows a dead load friction for the machinery equivalent to a indicated thrust by No. 1 screws gives 3·78 tons. When this deducted from the 5·3 tons shown by the curve there is left 1·52 tons, as the amount due to the friction of the screw shafting. From this we find that the horse-power to overcome the resistance, or initial friction of the screw shafting alone at 90·5 revolutions would be 170. The aggregate initial friction of the engines alone at 90·5 revolutions absorbs 400 horse-power, and the sum for the engines and shafting 400 + 170 = 570 horse power. The developed indicated horse-power, with the same speed of engines and the original screws would amount to 7330 and therefore the power expended on dead load friction was only about 8 per cent of the gross power. This shows that the engines were so well made and the bearings so well adjusted that they worked with unusually little friction. They compare well in this respect with the machinery of those single-screw vessels of the mercantile marine, the progressive trials of which were analysed by Mr. Froude, and explained at the meeting of 1876. In these he found the average value of this loss to about 13 per cent. of the indicated horse-power, and he assigns this at the probably general value.

I come now to the question why was the performance of No. 1 screws with four blades so much inferior to the performances of all the others? Authorities on the screw propulsion teach us that the effective thrust or efficiency of a screw propeller depend upon the quantity of water acted on in a given time, and the sternward velocity impressed upon it, and that it is always preferable to make the sternward velocity of the current small, by adopting a form of screw which will act on the largest possible quantities of water. Indeed, it has been said that if it were not for the objectionable element "surface friction," there would theoretically be no objection to an indefinite extension of blade area. In short, it has been always considered as essential to the efficient performance of screws generally, that their blade are should be large, and that the water be permitted to flow freely to them. Now, No. 1 screws with four blades appear to fulfil the above conditions very completely; for the blade area is undoubtedly very large, and as the run of the *Iris* is very fine, there is no obstrucion to an ample supply of water for the screws. Notwithstanding this, however, the results of the trials appear to show that on account of the large diameter of the screws, the shape, and the large area of the blades, combined with a fine pitch and consequent high rotary velocity, an extraordinarily large amount of power was absorbed in the surface friction of the blades. But seeing what a large amount of power appears to have been wasted at the highest speeds with No. 1 screws, it is difficult to believe that it can be all credited to this cause, and it is interesting to form an estimate of the amount absorbed in the surface friction of the blades. In our present state of knowledge it is difficult to determine this with even approximate accuracy, but the elaborate and valuable experiments made by Mr. Froude, in 1872, on the friction of planes, with surfaces of various kinds, travelling edgeways through water, furnish data which at all events enable us to form an estimate of the friction of screw blades, under certain conditions and with certain reasonable assumptions. The following are the results of the calculations which have been made—For Nos. 1 and 2 screws, which were coated with Sims's composition, the coefficient of friction has been taken as a mean of those given by Mr. Froude for a surface of varnish, and one of fine sand. For a mean length of surface of 3½ft., the width of the blades, this amounts to ·0062 for these screws. The polished surfaces of No. 3 screws were probably less smooth than Mr. Froude's tinfoil surface, and about intermediate between it and the varnished surface. For a mean width of 3ft. the coefficient for this screw, with 10 per cent. added as before, would be ·0038. No. 4 screws had a similarly smooth surface, but the mean width of the blade being 4ft. the coefficient becomes ·00365 inclusive of 10 per cent. for edge resistance.

Time will not admit of the details of the calculations being given, but the results showing the indicated horse-power expended on blade friction are as follows :—

No. 1 SCREWS.

At 91·04 revolutions per minute = 1120 indicated horse-power.
" 82·158 " " = 820 " "
" 65·105 " " = 410 " "
" 43·358 " " = 120 " "

No. 2 SCREWS.

At 88·89 revolutions per minute = 530 indicated horse-power.
" 81·2 " " = 400 " "
" 65·06 " " = 210 " "
" 45·07 " " = 70 " "

No. 3 SCREWS.

At 97·189 revolutions per minute = 420 indicated horse-power.
" 85.388 " " = 280 " "
" 61·343 " " = 110 " "
" 40·963 " " = 30 " "

No. 4 SCREWS.

At 93·25 revolutions per miuute = 230 indicated horse-power.
" 76·93 " " = 200 " "
" 59·085 " " = 90 " "
" 39·15 " " = 30 " "

To admit of the results being more clearly apprehended, curves were prepared showing the calculated surface friction for the several screws at the various speeds of the progressive trials. The base line gives the revolutions per minute, and the ordinates show the indicated horse-power absorbed in the surface friction of the blades, obtained as explained above. The curve for No. 1 screw is drawn in black, that for No. 2 in dotted black, that for No. 3 in red, and that for No. 4 in green. On one sheet were drawn horse-power curves for the trials with the several screws, but in this case the power expended in the friction of the screw-blades, as obtained from the above calculations, has been deducted from the total indicated horse-power as developed. The curve for No. 1 screws is drawn in black, for No. 2 in dotted black, for No. 3 in red, and No. 4 in green. From these curves it was seen at a glance that the performance of No. 1 screws is still much the worst, and that on the above assumptions respecting surface friction a large amount of power still remains to be accounted for. But it may be said the coefficient of friction taken for these screws was too small. To go to extremes, let us find the coefficient of friction on the supposition that the whole of the difference of the power is expended on the four blades of No. 1 screws, and the two blades of No. 2 screws was absorbed in surface friction, and we shall then find the power remaining available for the propulsion of the ship, and to overcome other resistances and see whether this appears to be enough. The question of augment of resistance will be considered farther on. The trial of No. 2 screws at the 15·726 knots' speed gives a ready means of making the comparison. The power developed to obtain this speed was 4370 with 88·9 revolutions, and the power which would be required with No. 1 screws to give the same speed of ship would be 6080, with 86·85 revolutions. The blade friction of No. 2 screws with the coefficient of ·0062 was shown to be equivalent to 530 indicated horse-power, and similarly with the same coefficient No. 1 screws to give the same speed of ship would absorb 897 indicated horse-power. The latter power divided by the former gives a ratio of 1·689. If F be taken to represent the indicated horse-power absorbed in the surface friction of No. 2 screws at 15·726 knots speed of ship, then whatever the coefficient may be 1·689 F will represent the indicated horse-power expended on the surface friction of the No. 1 screws at the same speed of ship. If P be taken to represent the indicated horse-power left after the assumed screw-blade friction has been deducted, P be the same for each screw to produce the same speed of ship.

$$\left\{\begin{aligned} 6080 - P &= 1{\cdot}689\ F \\ 4370 - P &= F \end{aligned}\right.$$
$$6080 - P = 1{\cdot}689\ (4370 - P)$$
$$\cdot 689\ P = 1300$$
$$P = 1890$$

The relation between the amount of power absorbed by blade friction of No. 1 and No. 2 screws at any speed of ship as represented by the proportion of the intercepted ordinates of the respective curves shown on sheet 10. In the case of No. 1 screws 6080 — 1890 = 4190 indicated horse-power would thus be absorbed in friction, and in the case of No. 2 screws 4370 — 1890 = 2480 indicated horse-power. This would correspond to a coefficient of friction ·0288, or about 4·65 times that of the coefficient taken in the first calculations.

It is evident that this latter estimate of the blade friction is far too great, for, as shown by the above calculations, it would absorb all the power developed by the engines except 1890, and this small amount which is left would have to overcome (1) the initial or dead load friction of the machinery ; (2) the working load friction of the machinery and pump resistances ; (3) the slip of the screws ; (4) the resistance of the ship at 15·726 knots speed; (5) the augment of resistance due to the action of the screws. Now, according to Mr. Froude's experiments with the model of the *Iris*, the indicated horse-power necessary to overcome the resistance of the hull alone—*i.e.*, the E.H.P.—would be 2160 at 15·726 knots speed. We see, therefore, that blade friction cannot be taken to account for anything like the whole of the bad performance of the No. 1 screws, and we must look for other sources of loss. First, it is probable that the four broad-pointed blades of No. 1 screws were more fruitful in eddy making than the others, and encountered more loss from this cause ; then, as the blades followed so closely on each other, taking, as it were, slices of water about 4½ft. thick, they might disturb injuriously the water for each other—that is, each blade probably came in contact with eddies set up by the blade which preceded it, particularly towards the points of the blades, where they were broadest and the velocity greatest. The eddies would, no doubt, be worst where the blades approached the sides of the ship, and the heads of the A brackets which carry the screw bearings. As the blades of No. 2 screws followed each other at intervals about twice as long, any eddies set up by one blade would probably be left behind before the other could sweep round upon them. It may be said in objection to this view, then, why was the performance of No. 3 screws, which had also four blades, so good ? These screws were of less diameter and area, and of rather more pitch ; the blades had narrow points, and they did not approach so close to the sides of the ship by 1ft. 1½in. The blades did not attain the same width as those of No. 1 screws until a distance of 6ft. 3in. from the sides of the ship was reached, and such blades would probably suffer much less rotary obstruction from disturbed water.

The second source of loss with the No. 1 screws must be, I think, in the greater augment of resistance with them than with the other screws. The four broad-pointed blades of large area set so nearly square to the line of motion of the ship, following each other so quickly, and approaching so near to the sides of the ship, must interfere much more than the other screws with the stream line motions of the water closing in at the stern to balance the head resistance.

Mr. Froude estimates that the disturbance of stream line motions by the screw in well-formed single-screw ships is equal to from 40 to 50 per cent. of increase upon the resistance of the ship, when towed at the same speed. With twin screws there is good reason to believe that the augment of resistance has a less percentage than with single screws ; but, on the other hand, there is the drag of the brackets or struts and the shaft tubes to be overcome, and in the *Iris* this drag is known to be exceptionally great. The run of the *Iris* is, however, very fine—as you will see by the section of the screws on sheet I.—and the screws may exercise less than the usual influence on the stream line motions, as compared with most twin screw ships. Still the amount of influence exercised must in itself be large, and a consideration of this may help us to understand why the original screws of the *Iris* gave so much worse results than the others. The great amount of attention which has of late years been given to the improvement of the designs of ships and engines has, it is feared, for a time prevented such full consideration from being given to the improvement and proper adaptation of the screw propeller as such an important subject deserves. It is understood that cases similar to that of the *Iris* have occurred in the mercantile marine, and if those who have had experience of any such cases would lay the particulars of them before the Institution, they would help to elucidate a subject on which much has yet to be learned.

H.M.'s Twin-screw Steel Despatch Vessel Iris.—Principal Particulars of Ship and Machinery.

Ship.

Length of the ship	300ft.
Breadth	46ft 1in.
Displacement at trial draught	3290 tons
Coal capacity...	750 tons

Engines.—The two sets of engines are placed in independent engine-rooms, separated by a transverse water-tight bulkhead. Each set consists of four cylinders, two high-pressure, 41in. in diameter, and two low-pressure, 75in. diameter. The high-pressure cylinders are bolted to the fronts of the low-pressure cylinders, and are partly recessed into them. The length of the stroke is 3ft. The high-pressure cylinders are fitted with expansion valves on the backs of the slide valves. An arrangement of change valves and pipes is fitted to the cylinders, by means of which each is put into direct communication with the boilers and condensers. The engines are thus capable of being worked as simple with steam of low-pressure. A surface condenser constructed of brass is fitted in each engine-room at the backs of the cylinders. The tubes are ⅝in. in diameter, and the total cooling surface of each is about 7000 square feet. One vertical air pump to each set of engines, 43in. diameter. and 21in. stroke, is driven by a rod off the foremost low-pressure piston of each set, and bell crank levers. Two centrifugal pumps 3ft. 9in, in diameter, are employed for circulating the water through the condensers. These are capable of pumping 500 tons of water from the ship in the event of a leak. The crank shafts are of wrought iron, 15½in. in diameter. The propeller shafting, with the exception of the aftermost lengths, which are of solid wrought iron, are made hollow, of Whitworth's fluid compressed steel. The diameters of the lengths inside the ship are 14½in. outside and 8in. inside; of the lengths in the stern tubes, 16in. outside and 10in. inside; of the lengths outside the vessel, 15½in, outside and 9½in. inside. The aftermost lengths of wrought iron are 15½in. diameter. The length of shafting outside the ship is 53ft. 6in. to the centres of the propeller bosses. Two brackets 20ft. 6in. apart are fitted on each side of the ship to support the shafts, which are covered with thin sheet iron casings to prevent ropes, &c., from fouling them.

Boilers.—There are twelve boilers, placed in two boiler-rooms, which are separated by a transverse water-tight bulkhead. The boilers face each other, and are fired from middle line boiler-rooms. The shells of the boilers are made of the same material as the hull ship, viz., Landore steel. The following are the dimensions of the boilers:—In after boiler-room, six three-furnace boilers, 12ft. 6in. wide, 13ft. 6in. high, 9ft. 7in. long. In the forward boiler-room, two three-furnace boilers, 12ft. 6in. wide, 13ft. 3in high, 9ft. 7in. long; and four two-furnace boilers, 13ft. 2in. diameter, 9ft. 6in. long. Diameter of the furnaces, 3ft. 1½in. Length of fire grates, 7ft. Total area of grate, 690 square feet. Diameter of boiler tubes, 3¼in. Length of boiler tubes, 6ft. 5¼in. Total tube surface, 15,900 square feet. Load on safety valves, 65lb. There are two fixed funnels, with ventilating pipes up their centres. The diameter of the forward funnel is 7ft. 8in. and of the after funnel 8ft. 4in. The height of the funnels above the dead plates of the lower furnaces is 67ft.

STRAINS ON CRANK SHAFTS.*

BY MR. J. T. MILTON, ENGINEER SURVEYOR TO LLOYD'S REGISTER.

OF all parts of marine engines that which requires to be renewed most frequently is the crank shaft. The majority of breakdowns of machinery at sea are caused by broken shafts, whilst those that break at sea are a small portion of the total number which are condemed and replaced owing to serious flaws being discovered in them. The great expense and inconvenience arising from the detention of vessels when being fitted with new shafts have led to the adoption by most engineers, in large engines, of crank-shafts made in halves, each half being a duplicate of the other, so that in the event of a breakdown on half only has to be renewed; and it is also the practice of some engineers, not only to make their shafts in similar halves, but to make each half reversible, so that in the event of a flaw appearing in any bearing, it can be turned into the forward bearing, upon which no twisting strain comes. Now there must be some cause or causes for this great mortality amongst shafts, and any discussion on this subject which would reveal any cause, and at the same time suggest a remedy for it, would be of great interest. Crank shafts might fail through being originally made of insfficient diameter for the work, they are designed, and in at least one noted case this was no doubt the reason; but in the majority of marine engines this is not the case, yet they sometimes break after only a few months' work. Another cause which might lead to their failure is bad forging, and although the fractures of shafts have in some instances shown either that the material was bad or that the piling of the iron was defective, yet in very many broken shafts the material is thoroughly good. If the material is good, and the shaft is of proper dimensions, and yet comes to grief, it must be through its being subjected to some specially severe strains, greater than those due to ordinary working. It is to the consideration of some of these strains that this paper is devoted. That some abnormal strains is the cause of flaws occurring in shafts is born out by the fact that in many shafts flaws are observed, marked at the ends, and carefully watched to see if they extend, and the shafts then run for months, and sometimes even for years, at full power, without any extension of the flaws, whilst the shaft must, in flawed state, be weaker than before. Most of the flaws for which its crank shafts are condemned occur at the angle between the web of the crank and the journal or crank pin, at the place where the forging is most likely to be defective, and they are evidently produced more by bending strains than by twisting; at these places the change of form of the shaft throws great local stresses on the material, and there can be no doubt that if these parts are made with a large radius the strength of the shaft is materially increased. Amongst the causes which tend to throw great strains on the shafting may be mentioned the presence of water in the cylinders, slackness of the brasses, and also the bearings being out of line. It is very difficult to calculate the amount of strain produced by the first of these causes quantitavely, as it depends upon the pressure which would open the relief valve or force the slide valve off the face, and thus afford an outlet for the water, and it is only too common to find the relief valves either set fast in their seats, or their springs rusted up solid, but on the supposition of the crank being very near the centre, the piston and cylinder cover, or bottom being absolutely rigid and there being no outlet for the water, the leverage of the other engine would be sufficient to produce an almost infinite force in the connecting rod, so that it is easily seen that, practically, water in the cylinders might produce an excessive bending strain on the shaft.

It is also difficult to estimate quantitavely the strain produced by slackness of the brasses, but in most engines the amount of steam cushioning is sufficient to reverse the direction of the pressure on the piston before the end of the stroke and the change of pressure in this place being gradual the slackness of the brasses is taken up gradually. In some cases, however were there is no cushioning the reversal of pressure takes place at the end of the stroke by the full steam pressure coming on the piston suddenly, and a blow, and consequently an impulsive strain in, is thrown on the shaft, the intensity of the strain depending upon the amount of slackness of the brasses. The effect of the bearings being out of line is to throw the greater part of the supporting forces of the shaft upon one particular bearing; and although it is improbable that a very unequal distribution of the forces at the bearings would long escape attention, owing to the bearings becoming hot, yet in the case of a hot bearing, to which all engines are at times liable, the usual practice of slacking back the nuts of the cap entirely relieves the bearing of all pressure on the up stroke, and for the up stroke at least the shaft is in the position of having one bearing taken entirely away, whilst if two bearings were to heat at the same time the case would of course be rendered still more serious. In endeavouring to calculate the strains actually coming upon a crank shaft, we meet with a little difficulty. The forces acting upon the crank pins are found directly from the indicator diagrams, and from them the twisting moments on the journals are very easily calculated, but the twisting on the crank pins, and also the bending strains on both the pins and journals depend also upon the forces exerted at the bearings; even when the the bearings are absolutely true the supporting forces are difficult if not absolutely imposible to calculate exactly, owing to the want of continuity of the shaft itself, but when the bearings are slightly out of line the problem is still further complicated.

I have made some calculations of these strains in the cases of five engines of different types, for the purpose of ascertaining the extent to which they might be increased by the bearings being out of line. In order to do this, I have found the strains on the various journals and crank pins under ordinary conditions, and also under the conditions that would exist if one of the bearings were taken away, this representing a limit beyond which the effects of untrue bearings is unlikely to proceed, whilst, as I have noted, it is by no means an unlikely condition for the shaft to be in. The strains are repesented by the diagrams, the base line representing the angular position of the crank-shaft, in all cases starting from the forward crank upon the top centre, whilst the heights of the curves at any ordinato represent on the scale attached the strain the shaft is subjected to in that position. The curves show, first, the twisting moment; secondly, the bending moment; and, thirdly, the twisting moment which would, if acting alone, produce the same strain on the shaft as the bending and twisting moments combined. In all these cases I have taken into consideration the weight and inertia of the moving parts, and also the obliquity of the connecting-rod, as I find the results very different to those obtained by neglecting them; but in considering the bending moments I have assumed that the forces upon the bearings are concentrated at their centres, instead of being distributed along their length. This gives a result rather greater than would be obtained if we considered them uniformly distributed but as the same assumption has been made in the case of the bearings being taken away, the ratio of the strains in the two cases is lessened, because distributing the forces has a greater effect when the bearings are close than when they are far apart.

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* Read at the Institution of Naval Architects.

I have considered it unnecessary to examine the case in which the third or fourth bearings are adrift, as they will be practically the same as with the second or first bearing adrift. In all the cases I have taken the forces at the bearings to be the same as they would be provided the shaft were of uniform section throughout, this being considered to be as near an approximation as could be made. The first and simplest case that I have taken is that of a single engine, which I will call Engine A. I have taken one of the compound type—in fact, the half of Engine B—high-pressure cylinder 48 inches and low-pressure 83 inches diameter; length of stroke 5ft., steam pressure 70 lb. per square inch. In this case the forces at the bearings must be nearly alike, and the bending moment on the crank pin will be half the load on the piston by half the span of bearings. If, however, the effect of the other bearings was to support the shaft, so as to put it in a similar condition, as for as bending is concerned. as a girder fixed at one end and supported at the other, the maximum bending moment is three-fourths of that given above, but it occurs in the aft bearing. The actual strain must lie between these two cases, and must be considerably nearer the first. From these diagrams it appears that in the best working condition the shaft is strained 1·38 times as much as it would be by the twisting moment acting alone, such a strain as in fact comes upon the tunnel shafting, whilst the effect of taking away the support of the forward bearing is to double the strain on the shaft. The twisting moment on the after bearing and also on the tunnel shaft is shown by a curve, and from this it appears that in this engine the maximum twisting strain is 2·1 time the mean. The next case, Engine B, is that of a compound engine with four cylinders, the cranks being at 90 deg. The high-pressure cylinders are 48 inches diameter, the low 83 inches; length of stroke, 5ft.; steam pressure, 70 lb. per square inch. This type of engine might also be taken to represent the simple engine with two equal cylinders, cranks at right angles. It will be seen that the greatest strain comes upon the after crank-pin. In this engine it appears that the ratio of greatest to mean twisting moments in the tunnel shaft is 1·37 to 1; the crank shaft is subjected to a strain equal to that which would be caused by a twisting moment 1·15 times the greatest twisting moment in the tunnel shaft, when the engines are in good working order; whilst the first bearing, being adrift, causes a strain on the shaft twice as great as that due to ordinary working, and the second bearing adrift causes the shaft to be strained 1·36 times as much as when the bearings are in proper order.

The next case, Engine C, is that of the commonest type of marine engine, viz., compound, with two cylinders and cranks at right angles; and Engine D is also of the compound type. but the cranks are at an angle of 130 deg.; in each case there are four bearings to the crank shaft. Engine C has cylinders of 44 inches and 72 inches in diameter, a stroke of 3 feet 6 inches, and a steam pressure of 60 lb., whilst Engine D has cylinders of 26 inch and 52 inch diameter, a stroke of 2 feet 6 inches and a steam pressure of 80 lb. per square inch. In Engine C the ratio maximum to mean twisting moment is 1·48 to 1, whilst in Engine D the ratio is 1·77 to 1. In both engines, in ordinary working, the after crank-pin is the part which is most strained; in Engine C it is strained 1·11 times that due to greatest twisting moment, while in Engine D it is strained 1·05 times as much as the tunnel shhafting. If the first bearing is taken away the shafts are strained in Engine C to twice and Engine D to 1·46 times that due to ordinary working, while slacking second bearing increases the strain on the shaft in the ratios of 1·43 and 1·06 times in the two engines.

The next case, Engine E, is also that of a compound engine with two cylinders; the cranks in this case are set at an angle of 135 deg., but there only three bearings to the crank-shaft; the diameters of the cylinders are 34 inches and 60 inches, the stroke is 3 feet, and steam pressure 60 lb. per square inch. In this case, we see that the shaft is strained twice as much as in ordinary working, whilst when the middle bearing is adrift, the shaft is strained 1·28 times as much as ordinary working. These results show what a great influence upon the strains acting on a crank-shaft the position and truth of the bearings exert; and in considering these strains it is to be borne in mind that it often happens that other causes are also at work increasing the strains on the shafting at the same time; for instance we might have slack brasses in the connecting rods, hammering on the shaft at the same time as the bearings are adrift. It must also be noted that they are not strains which come only a few times on the shaft, for with the engines making 60 revolutions per minute they would be repeated 1000 times in seventeen minutes, whilst in the case of the bearings being set out of line the strains this would cause—reckoning it only once per revolution—would be repeated upwards of 86,000 times in the course of the day running at 60 revolutions per minute.

	Rato of maximum to mean twisting moments.	Ratio of greatest stress on crank shaft to that on tunnel shaft in proper working order.	Ratio of greatest stress on shaft with first bearing taken off to that when in proper working order	Ratio of greatest stress on shaft with second bearing taken off to that when in proper working order
Engine A...	2·1	1·38	2·0	—
Engine B...	1·37	1·15	2·0	1·36
Engine C...	1·48	1·11	2·04	1·43
Engine D...	1·77	1·05	1·46	1·06
Engine E...	1·94	1·21	2·05	1·28

GAS-LIGHTED BUOYS.

In the House of Commons, a short time since, Mr. Gourley asked whether the President of the Board of Trade had considered how far it was possible to illuminate coast-buoys at night with artificial light. Mr. J. G. Talbot, in reply, stated that a project for illuminating buoys with gas had been for some months under consideration, and some very interesting experiments were being made by the Trinity House in the matter. The system here referred to is that devised by Pintsch's Lighting Company, of Metropolitan Chambers, New Broad Street, for charging buoys with gas under pressure, so that the light burns for many days and nights without intermission. The primary application of this system was to the lighting of railway carriages, and its success in that direction led to its application to buoys, which, so far, has proved most successful. The essence of the principle lies in the special manufacture of the gas and its storage for use under pressure, whether in respect of railways or buoys. We will first briefly describe its manufacture, and afterwards its application in practice. And we may premise that the system has long since passed the experimental stage, having been in use in Germany for six or seven years, and in England for about three years. The gas is made of the refuse of the shale oil works, or from any other waste fatty matter, which can always be had at a very low cost. This refuse is fed into a system of cast-iron retorts set in a furnace. The tar flows off to a store tank for ordinary use, while the gas passes from the retorts through condensers, washers, and purifiers successively to the meter, and thence to the gas-holder. Here it is temporarily stored, and from this holder it is pumped by an engine to tanks, where it is stored for use under a pressure of ten atmospheres, or 150 lb. per square inch. Notwithstanding this amount of compression, the gas retains its permanency, and is not found to condense or to cause any deposits in the pipes. The compression pump has two cylinders, in the first of which the gas is compressed to 60 lb. per square inch, the final compression to 150 lb. being effected in the second cylinder.

The experiments with the gas-lighted buoys, according to *The Times*, were commenced about eighteen months since, when two experimental buoys of cylinder shape, 5 feet high and 3 feet in diameter, and surmounted by a lamp, were charged with compressed oil gas, at a pressure of 90 lb. per square inch. They were placed in the sea, where they burnt steadily and brightly for a number of days and nights in all weathers. When this was placed before the Trinity Board, they instructed their executive officers to investigate the matter. A buoy similar to the above was then tried at the Trinity Wharf, where it was subjected to a variety of tests. The superintendent reported to the Board that the buoy showed a brilliant light from the 29th of August to the 25th of September, 1878, the flame becoming reduced on the 26th, when the light went out. This buoy was then re-filled and anchored at the mouth of the Thames. In this position, and during boisterous weather in October last, the buoy performed its required service for the regulated period of twenty-eight days. It showed a bright light, burning day and night for that period, with such effect that it is stated to have been visible at a distance of four miles from the deck of a vessel. The Elder Brethren are so far satisfied with its performance, that they have ordered two large buoys to be constructed for their use. Each of these is to be of sufficient capacity to carry a charge of compressed gas sufficient to supply a bright light for a period of from four to six months continuously, without being re-filled.

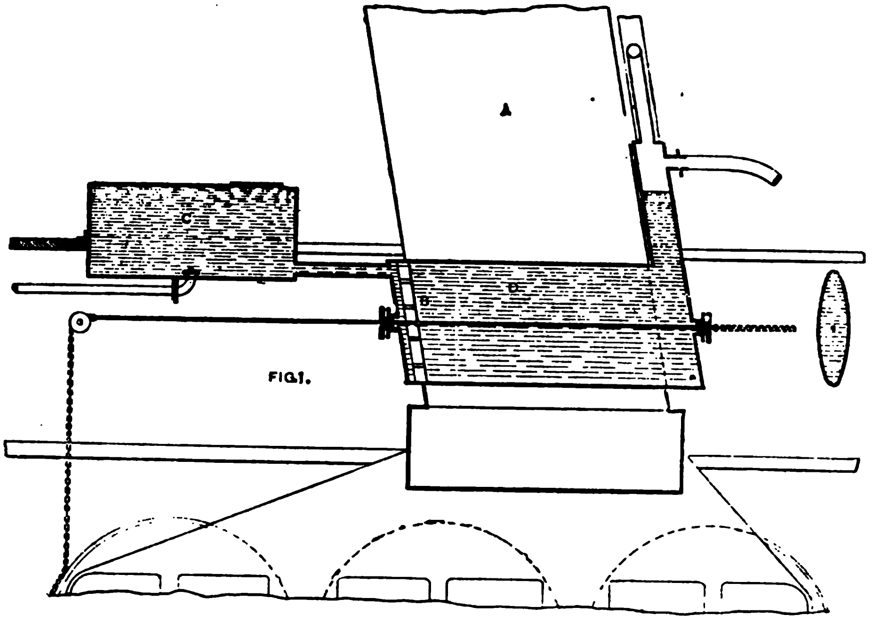


FIG.1.

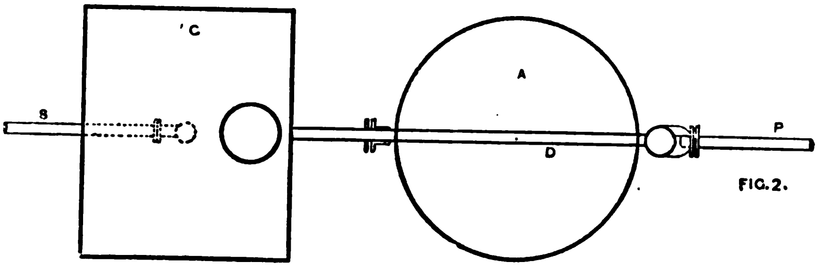


FIG.2.

WIMSHURST'S MARINE FRESH WATER APPARATUS.

IT was we believe, to the ingenuity of a seaman cast away on a waterless shore, that the first attempt at distilling sea, to obtain potable water was due. But fresh water, which tends to run short in the case of a protracted voyage, is manifestly greatly preferable for the boilers of steam vessels, and in the case of steel boilers, which must largely supplant the others, the purest fresh water is essential. Many ingenious arrangements have thus come into use for the supply of distilled feed water, and of these the apparatus illustrated above is one of the most valuable. In the majority of rival plans a special furnace is required, in this the heat escaping from the main furnace is utilized. Wimshurst's apparatus may be described as a salt-water vessel D, seen in Fig. 1 and 2, and in the section to the right of Fig 1. It is in the full-size apparatus about 3 inches in thickness, and is fitted through the funnel A in a suitable place, where the high temperature of waste gases enables it to generate steam, which is conveyed through P to any distilling apparatus. The advantages are, that it would save the entire use at sea of the donkey boiler, and the man usually engaged in attending it. It also saves the whole of the fuel now employed for providing fresh water for passengers and for freshening the boiler water. Fig. 1 is a sectional elevation of the arrangement, and Fig. 2 a plan. At C is a cistern supplies with salt water, and by which the generator D is kept full. A stuffing box is fitted at each end of the generator, through which a rod passes, which is fitted with a scraper B for the purpose of removing the salt scale from the interior surface. This is afterwards taken out from the bottom of the generator from a hand hole not shown. The scraper must be occasionally pulled by the hand chain from one end of the generator to the other; the steam from the generator passes along the pipe F to the still. A safety valve is, of course, fitted to the generator. The apparatus seems to provide the means of obtaining an unlimited supply of fresh water at, practically, no cost. Mr. Everdon Wimshurst is the inventor, and Messrs Normandy, Stilwell, and Co., Custom-house Station, Victoria Docks, are the makers.

PATENT SAFETY SALOON BOAT.

Last month we referred to certain plans for insuring the safety of river passengers against such casualties as that which befel the *Princess Alice*, and of these that of Mr. R. Dougan has now been patented, and proceedings are being taken to carry it out by means of a company. For the following general details of this scheme we are indebted to the inventor.

The *Princess Alice* was about 220 feet long. Mr. Dougan's plan is simply, in the first place, to divide a vessel of this length, when building, into two sections. The first part is to be a small-sized paddle steamboat, to carry the engines, &c., with a number of passengers, who should be strictly confined to the after part of the boat, the front part being reserved for the captain and crew, so as not to interfere with efficient working, as boats are generally struck in a collision somewhere in the forward parts. The section or floating saloon will be constructed on a particular plan, without any machinery, with the saloon on the level deck on the hull, and a wide door at each side on universal hinges, so that egress would be rapid and immediate, the saloon to be coupled to the boat in front, by a self-acting plan, whereby, in the event of the boat in front being sunk, the coupling would at once disconnect itself from the saloon, and leave it completely disentangled. If intended to carry 800 passengers, 400 only should be allowed on the steam-boat in front, and 400 on the saloon. The saloon next to the steam-boat will communicate by a broad gangway, or bridge, admitting four persons abreast, so that if the boat in front was sinking, every one of the persons on the boat could escape in three minutes on to the floating saloon next to her. By this method every person on board might be saved without difficulty. Each saloon would have to carry a little anchor, so that if the boat went down, leaving the saloon adrift, it would be prevented floating down the river.

There are several other improvements, both for the safety, comfort, and convenience of the passengers, which we will now enumerate. The saloon is to be built on the level decks of specially constructed hulls, to insure steadiness with a light draught of water, so as to glide along as speedily as possible. Between the bulwarks or sides of the hulls and the saloon where the passengers are seated, there will be a space to walk of five feet all round. That space will act as an additional security for the passengers, if, in event of the saloons being struck by another vessel on the side, the vessel striking the saloon boat must cut through five feet of the strong solid hull before reaching the saloon (but this supposition is scarcely probable). There will also be a promenade on the roofs of the saloons, approached by wide stairs at each end, so as to afford a double means of ascent or decent; the promenade on the roof to be divided down the centre by a railing, so that no undue number of passengers can crowd unto one side to cause any overbalancing of the saloon.

STANNAH'S PATENT STUFFING BOX.

WE here illustrate a superior form of stuffing box, the invention of Mr. J. Stannah of Southwark Bridge Road. This simple arrangement, which is applicable to the packing either of a piston or revolving rod, and may be advantageously applied where the ordinary form is inadmissible, owes its invention to a difficulty experienced by Mr. Stannah in keeping the pendulum pin of his well-known pumps tight. In these machines every thing depends on the exact fit of the working parts and their being kept in that state; but it was found that the ordinary method of packing was useless. Accordingly the inventor set his wits to work to provide a remedy, and the present simple method having suggested itself, was found to work admirably. It is now being adapted at the Southwark Bridge Road Works, with great advantage, in place of the ordinary stuffing box, possessing as it does the valuable recommendations of simplicity, occupying little space and great reduction in first cost.

FIG. 1

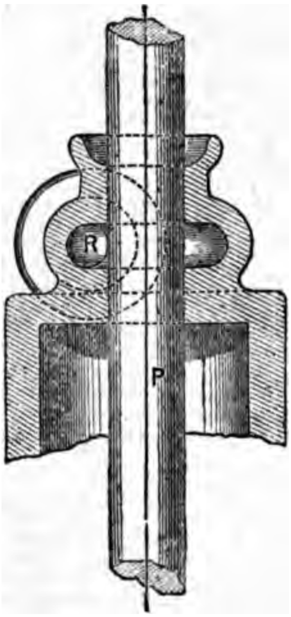


FIG. 2.

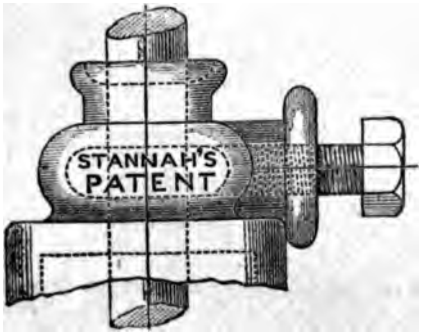


FIG. 3.

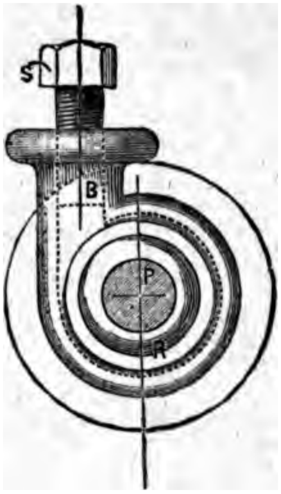
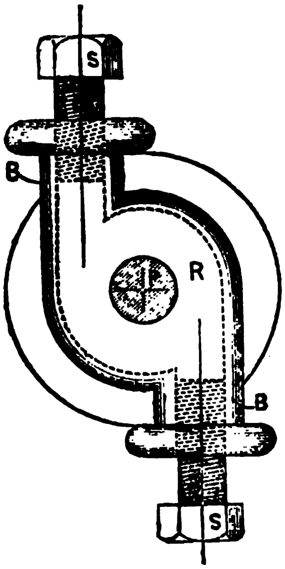


FIG. 4.



In Figs. 1, 2, and 3, P is an ordinary piston, slide valve, or pump rod. R is a recess left void in the casting, or it may be bored out after. B is a boss with a tapped hole in it, in which a screw S is placed, the hole being drilled at a tangent to the recess R. The packing is put into the recess R, through the hole just described, and kept in its position by means of the screw S. The placing of the hole at a tangent to the recess enables the packing to travel freely round the piston rod, till it meets the supply and has filled the recess.

In Fig. 4 we have shown a modification in which two supply holes are provided. Some of the advantages claimed for this arrangement are that the packing can be kept tighter; at least two loose parts are saved, the gland and one screw; the engine or machine to which it is applied is rendered more compact; the liability of the rod to get jammed through the ordinary glands being unevenly tightened down done away with, and to put more packing in it is only necessary to take out one screw.

WATER-TUBE AND FIRE-TUBE BOILERS.

(Continued from Page 9.)

An Account of the Experiments made by Chief Engineers Loring and Baker, U.S. Navy, on a Horizontal Fire-Tube and a Vertical Water-Tube Boiler, at the Washington Navy Yard, to ascertain their relative Economic Vaporization with different kinds of Coal

BY CHIEF ENGINEER ISHERWOOD, U.S. NAVY.

[*From the Journal of the Franklin Institute.*]

EACH tube-box contains four hundred and fifty vertical water-tubes of seamless brass one-tenth of an inch thick, expanded on one side and riverted over on the other side of their tube-plates. Those tubes are 2 inches in external diameter and 23½ inches high in the clear between their tube-plates. They are arranged in fifteen rows crosswise the boiler, and thirty rows lengthwise the boiler; their axes being in straight lines, or not staggered. The distance between the axes of the tubes crosswise the boiler is 3 inches, and lengthwise the boiler 2¾ inches.

Both tube boxes discharge into one uptake which at the top, delivers the gasses of combustion into a horizontal sheet-iron flue connecting the uptake to the vertical water-tube boiler with that of the horizontal fire-tube boiler, and from the centre of this flue the chimney, common to both boilers, rises. The uptake has the usual doors for access to the tubes for sweeping, etc.; and the furnace-doors were thoroughly perforated for the admission of air above the incandescent fuel on the grates.

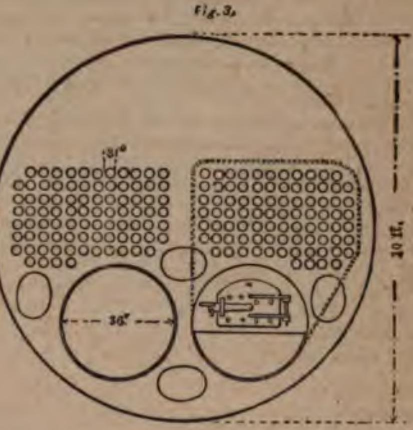
The following are the principal dimensions and proportions of the vertical water-tube boiler:

Diameter of the shell, ...	10 ft.
Length of the shell, exclusive of the uptake, ...	9 ft.
Number of furnaces, ...	2.
Breadth of furnaces, ...	3 ft.
Length of grates, ...	9 ft.
Total area of grate surface, ...	36 sq. ft.
Total number of tubes, ...	900.
External diameter of tubes, ...	2 in.
Internal diameter of tubes, ...	1·80 in.
Length of tubes in clear of tube-plates, ...	23·50 in.
Total cross area for draught above the bridge walls, ...	5·55 sq. ft.
Total cross area of draught through the tubes,	5·55 sq. ft.
Cross area, of the chimney, ...	12·57 sq. ft.
Diameter of the chimney, ...	4 ft.
Height of the chimney above the level of the grate-bars, ...	60 ft.
Heating surface in the two furnaces, ...	99·03 sq. ft.
Heating surface in the two back connections, ...	68·00 sq. ft.
Heating surface in the two tube-boxes, ...	131·10 sq. ft.
Heating surface in the 900 tubes, measured on their inner circumference, ...	830·55 sq. ft.
Heating surface in the one uptake, ...	5·32 sq. ft.
Total water heating surface in the boiler, ...	1,104·00 sq. ft.
Square feet of water heating surface per square foot of grate surface, ...	30·97.
Square feet of grate-surface per square foot of cross area above bridge-walls, ...	6·49.
Square feet of grate-surface per square foot of cross area through tubes, ...	6·40.
Square feet of grate-surface per square foot of cross area of chimney, ...	2·87.
Water room to 6 inches above tubes, ...	310 cu. ft.
Steam room from 6 inches above tubes, ...	153 cu. ft.
Greatest height of steam room, ...	2·75 ft.
Weight of boiler, exclusive of uptake, chimney uptake doors, furnace doors and frames, water, grate-bars, bridge-wall, etc., but inclusive of manhole and handhole plates, ...	30,605 pounds.
Weight of uptake, uptake doors and furnace doors,	1,100 pounds.
Weight of grate-bars and bearers,...	1,892 pounds.
Weight of cast iron bridge-walls and their brick facing, ...	810 pounds.
Weight of non-radiating cement covering for boiler, ...	6,000 pounds.
Weight of water in boiler, ...	19,323 pounds.
Total weight of boiler, exclusive of chimney, ready for service,...	59,730 pounds.

THE HORIZONTAL FIRE-TUBE BOILER.

The shell of the horizontal fire-tube boiler is a cylinder with flat ends at right angles to its axes. The front end is also the front tube-plate. This cylinder is ten feet in diameter and nine feet in length, externally. The uptake, which is sheet iron bolted to the front end of the cylinder, projects beyond this length. The plates of the shell are eleven-sixteenths of an inch thick, and double rivited. The flat ends of the shell above the tube-boxes are stayed directly across with iron rods 1⅝ inches in diameter and 10 inches between axes, attached to double angle iron reveted vertically to the ends. All other flat surfaces are stayed with socket-bolts 1⅛ inch in diameter and 6 inches between centres.

FIG. 3.

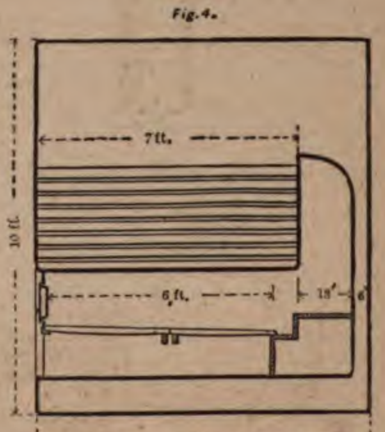


There are two furnaces contained in horizontal cylinders of 3 feet internal diameter and 7 extreme length. The axes of these cylinders are in the same horizontal plane and 42 inches apart. The cylinders are composed of iron plates ½ inch thick, butted, and double-riveted to inner welts below the grate bars; they are single riveted to the boiler-shell and are in three lengths, flanged where the lengths meet, and single-riveted thereby through a ring placed between them. The grates within these cylinders are 6 feet in extreme length, composed of cast-iron bars in two lengths of 3 feet each.

The bridge-wall is of cast-iron faced with fire-brick and is 6 inches high above the level of the grates. The top of the grates is 18 inches below the crown of the furnace, at the front, and 21 inches below it at the back.

Each furnace has a separate back connection 18 inches long, lengthwise the boiler, with its top rounded on a quadrantal arc of 14 inches radius. Its back is flat and separated from the back end of the boiler-shell by a flat water-space six inches wide, including thicknesses of metal. The bottom of the connection is a horizontal extension of the bottom of the cylinder containing the furnace and the sides are flat. The inner side is vertical and rises from the horizontal diameter of the furnace. The outer side, at top, is vertical for the depth occupied by the tubes, and thence slopes inwards on a tangent to the cylinder containing the furnace. The cast-iron bridge-wall of the furnace is extended clear across the connection so as to occupy the whole of the lower portion.

FIG. 4.



From each back connection to the uptake proceed 86 horizontal fire-tubes of seamless brass, one-ninth of an inch thick ; 70 of them are expanded on one side and riveted over the other side of their tube-plates, and the remaining 16 act as stays, having nuts upon their outer ends. The boiler thus contains 172 tubes, of three inches outside diameter, and 6 feet 10⅝ inches length between the tube-plates, which are of eleven-sixteenths inch thick iron. These tubes are arranged in twenty-four rows horizontally and eight rows vertically, but the number in all the rows is not equal. The top row contains twenty-two tubes, the bottom row contains eight tubes, the row next to the bottom, twenty-two tubes, and each of the other rows twenty-four. The two groups of tubes are separated by a water space 11 inches wide in the clear. The distance between the axes of the tubes of each group is, vertically, 4 inches, and, horizontally, 4 one-tenth inches.

All the tubes discharge into one uptake, which at the top delivers the gases of combustion into a horizontal sheet iron flue connecting the uptake of the horizontal fire-tube boiler with that of the vertical water-tube boiler, and from the centre of this flue, the chimney, common to both boilers, rises.

The uptake has the usual doors for access to the tubes for sweeping, etc., and the furnace doors were thoroughly perforated for the admission of air above the incandescent fuel on the grates.

The following are the principal dimensions and proportions of the horizontal fire-tube boiler :

Diameter of the shell	10 ft.
Length of the shell, exclusive of the uptake	9 ft.
Number of furnaces	2
Breadth of furnaces	3 ft.
Length of grates	6 ft.
Total area of grate surface	36 sq. ft.
Total number of tubes	172
External diameter of tubes	3 in.
Internal diameter of tubes	2⅞ in.
Length of tubes in clear of tube-plates	82⅝ in.
Total cross area for draught above the bridge-walls...	5·55 sq. ft.
Total cross area for draught through the tubes... ...	7·24 sq. ft.
Cross area of the chimney	12·27 sq. ft.
Diameter of the chimney	4 ft.
Height of the chimney above the level of grate-bars	60 ft.
Heating surface in the two furnaces	64 sq. ft.
Heating surface in the 172 tubes, measured on their inner circumference	861·24 sq. ft.
Heating surface in the two back connexions	76·5 sq. ft.
Heating surface in one uptake, ...	17·26 sq. ft.
Total water heating surface in the boiler	1019 sq. ft.
Square feet of water heating surface per square foot of grate surface...	28·30
Square feet of grate surface per square foot of cross area above bridge walls	6·49
Square feet of grate surface per square foot of cross area through the tubes	4·97
Square feet of grate surface per square foot of cross area of chimney...	2·87
Water room to 6 inches above tubes	325 cubic ft.
Steam room from 6 inches above tubes	161 cubic ft.
Greatest height of steam room	2·35 ft.

MANNER OF MAKING THE EXPERIMENTS.

With the precedingly described boilers, six experiments were made, of thirty consecutive hours duration each, and in precisely the same manner. Of these experiments, two were made with the horizontal fire-tube boiler, one being made with Pennsylvania anthractie, and the other with semi-bituminous coal from the Cumberland mines of Maryland. The remaining four experiments were made with the vertical water-tube boiler and, of these, two were made with Pennsylvania anthracite and were nearly repetitional ; one was made with semi-bituminous coal from the Cumberland mines, and the last was made with a bituminous caking coal of unknown locality.

The anthracite was of better quality than the average, and the semi-bituminous coal was of poorer quality than the average, in this respect—that the former had a less, and the latter had a greater percentage of refuse than the average. The average proportion of refuse in fair merchantable anthracite is one-sixth, and in fair merchantable semi-bituminous coal, one-eighth. Of course the quality of the gasifiable portion of these coals is not affected by their percentage of refuse.

The vaporization took place under the atmospheric pressure, increased slightly by the resistance opposed by the escape pipe to the effluent steam.

Although the boilers stood side by side in the boiler house, and *delivered* their gases of combustson into the same chimney, they were not experimented with simultaneously. The experiments with the horizontal fire-tube boilers were made first, and those with the vertical water-tube boiler last, a partition of brick masonry being temporarily placed in the horizontal flue connecting the uptakes of the boilers, just beyond the chimney, in each case. Of course, by this arrangement the entire chimney, which was of sufficient cross area for both boilers, was used with each. This, and the fact that the experiments were made at different times under different atmospheric conditions, prevented the possibility of ascertaining the maximum rates of combustion for the two boilers. In the experiments as actually made, there were no attempts to force the fires, which were allowed to burn without further attention than what was required to keep them level, clean and free of holes and about ten inches thick.

The experiments were made during the months of March and April, 1873, and the boilers were thoroughly protected by a non-conducting covering of asbestos.

In commencing an experiment, the fires, of 10 inches thickness, were brought to a steady action with the steam freely blowing off through the escape pipe, and with the water in the boiler at about 6 inches above the top of the tubes. The fires were then carefully leveled, the height of water in the boiler exactly adjusted, the thickness of the fire noted and the experiment held to commence. Up to this time no account was taken of the coal and water ; but, from this time to the expiration of the thirty hours, all the coal thrown into the furnaces was accurately weighed, and all the feed-water admitted to the boiler was accurately measured in a tank, and the quantities noted hourly. At the end of the experiment the fires were thoroughly cleaned and made of the same thickness as at the commencement, with the water level at precisely the same mark.

All the coal and all the refuse from it were weighed on the same scales in the same iron tub, counterbalanced to prevent error. The same firemen were employed throughout.

During the experiments, regular watches were kept by Assistant Engineers of the Navy, who entered in the columns of a tabular log all necessary observations from hour to hour.

The data and results of the experiments will be found in the following table, in which the headings of the columns and the descriptions of the quantities on the lines are so full that no further explanation is needed. The observed data are from the original notes of Chief Engineer Baker, but the computions were made by the writer.

To be continued.

MARINE BOILERS AND HIGH-PRESSURE STEAM.[*]

BY MR. DAVID C. HAMILTON.

PREMISING that the subject was of vital importance to every marine engineer and ship-owner, the author referred to a paper on "Marine Boilers," read at the Glasgow meeting, of the Institution of Naval Architects, in 1877, by Mr. Charles H. Haswell, of New York, and said that in his opinion there was nothing to suit the marine engineering practice of this country, and that none of the rules given by Mr. Haswell were of much utility for the young engineer to copy so as to be of service to him in scheming or designing boilers for any given purpose. If the members would make a careful analysis of any of the rules referred to they would find that they would not arrive at results coming at all near the practice of this country ; and it was especially true in the case of heating surface, length of tubes, and formulæ for strength of boiler details. In the handy book issued by the Board of Trade the engineer had got everything he required in the way of rules for scantlings to suit any desired boiler pressure. The little book had, in a very short time, taught the engineers of this country how to proportion the strengths of the boiler details, more than any publication known to the author ; and he thought that boilers made in Glasgow or elsewhere should have no difficulty in getting a fresh certificate at any future survey in another port, if originally constructed in accordance with the Board of Trade rules ; in fact, the book referred to, so far as boilers are concerned, has assimilated the whole marine engineering practice throughout the kingdom. Another paper had been read on the same subject at the meeting of the Institution of Naval Architects, the author being Mr. Milton, surveyor to Lloyd's Registry. The author characterised it as being really a good paper, well worthy of the medal awarded on account of it, when compared with Mr. Haswell's paper. Some good hints might be gathered from it by any person who would read it carefully.

The designing of marine boilers was left very much in the hands of the engineer, and the article produced by him depended, as to whether or not it embodied all the latest improvements, on the price paid by the shipowner. What the "latest improvements" were, however, it was very hard to say, the present form of marine boiler being very much what it was ten years ago. If pressures something like 500 lb. per square inch became fashionable, it was certain that the present type must be abandoned and some other one substituted. He might say up to the present time the average successful pressure generally did not exceed 70 lb per square inch. Some engineers have gone up to 90 lb., and would go further but for the thickness of the shell plates. For his own part, he saw no difficulties in the way of using steam at 100 lb. pressure ; and now that the Board of Trade and Lloyd's Committee had allowed the use of steel at a considerable reduction in thickness, when compared with iron, there were no difficulties, so far as he could see, in making boilers work with safety at that pressure up to 13 feet in diameter, the plates required not being over 1 inch or 1⅛ inch in thickness for such a diameter of boiler. At the same time, he did not anticipate any trouble arising from the use of steam at 100 lb. pressure either with the engines or in the construction or maintenance of the boilers, any more than if wrought at 60 or 70 lb. pressure. His opinion was that a boiler made for, and working at 100 lb. pressure, if properly taken care of, would last as long, and carry the original pressure for as many years, and with as much safety, as one made for a pressure of twenty lb., all other things being equal. The furnace was the only weak part of the boiler with a pressure of 100 or 120 lb., and the subject required some careful consideration if the diameter of the furnace approached 48 inches. The common mode of strengthening the furnace was to make the plates thicker, but that could not be judiciously done above one-half or nine-sixteenths inch. Then came the Bowling ring and the Adamson joint, the latter involving the construction of the furnace in two or more lengths. Although the Bowling ring might strengthen the furnace, and allow of a great amount of expansion taking place on the furnace crown, it presented two rows of circumferential seam riveting to the fire, and too much material between the fire and the water. The Adamson joint had done well, although in some cases it had failed by having too small a radius. Some engineers objected to the Adamson mode of strengthening the furnace, believing that, instead of strengthening, it produced a weakening effect, the total strain having to be resisted by the reduced material caused by rivet holes. Furthermore, they alleged that, although the furnace might be strengthened by the rings for a cold-water pressure, when the boiler was making steam and everything was hot, the conditions were so altered that the rings tended to weaken rather than to add strength to the furnace. The author's opinion was that, with a radius of 1½ to 2 inches and a 3½ inch radius of crown plate to the tube plate there was sufficient room for any expansion that might take place, and that the Adamson rings were superior to the Bowling rings. Another new idea in the strengthening of boiler furnaces had been brought out by Mr. Sampson Fox, in his patent corrugated flues or tubes ; and from late experience they had proved themselves to be 100 per cent. stronger than plane tubes ; indeed, while the latter had given way at a pressure of 200 lb. per square inch, the corrugated tubes only yielded when the pressure rose to 450 lb. Other advantages had been claimed by the patentee, such as their superior power of generating steam, giving allowances for expansion, improved circulation, &c.

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[*] Read at the ordinary meeting of the Graduates Section of the Institution of Engineers and Shipbuilders in Scotland, on March 11th

The author went on to remark that, when pressures got up from 30 to 60 lb., shipowners said their bills for boiler repairs would increase in about the same proportion. Whether that was so or not, he had never found it to be the case ; indeed, he considered that the general type of boiler made twenty years ago for 20 lb. pressure was more costly to keep up than the boiler of the present type working at 70 lb. pressure. From what he had now said, the members would easily see that he considered the cylindrical boiler far superior to the old-fashioned flat-sided boiler with dry or wet bottoms. In designing such a boiler, the engineer was very often compelled to put the largest possible amount of so-called heating surface into the least possible amount of space in the ship, and the result was small boilers with, perhaps, small furnaces, small combustion chambers, and a superabundance of tube surface, whereas he was in favour of good-sized boilers, extra large furnaces, large combustion chambers, and a limited amount of tube surface. No furnace should, in his opinion, be less than 48 inches in diameter, and over it if possible. Some firms having boilers with furnaces of that and similar diameters contracted the mouth of the furnace to say, 40 inches in diameter, so as to arrange the furnaces closer together and lower, and still have room for riveting. By doing that, the value of the large diameter was diminished, one reason being that as the ashpit was lower than the mouth of the furnace the areas of admission for air above the bars was reduced. Small furnaces had the same defects, but on a larger scale, and they caused too great a current through the furnace. If possible, the furnace bars should not, in length, exceed the diameter of the furnace, and should be made as thin as possible. The area for admitting air through the furnace mouth above the bars ought not to be less than 1·28 of the firegrate or 5 inches per 1 foot of firebar, and the holes admitting the air ½ inch diameter, and well distributed around the furnace mouth. Such a distribution of air would tend to economy of fuel and prevention of smoke, although at the same time, an excess of air might prevent black smoke being formed and yet not be very economical, so far as consumption of fuel is concerned, inasmuch as the high temperature of the furnace was reduced, and as the reduction of temperature reduced the draught the consequence was that the gases passed off unconsumed, and did little good in adding heat that was available for generating steam. In a great many boilers the combustion chamber was too small, and seemed only to serve the purpose of changing the direction of the current of the heated gases so as to enter the tubes, and not really as a combustion chamber. The aim of such a chamber should be to have the combustion as complete as it was in the furnace, which could only be arrived at by keeping it at a high temperature. The size of a combustion chamber, fore and aft of a boiler, was seldom equal to the diameter of the furnace in length, which it might with advantage be. In many, if not in all cases, the chamber could be advantageously lengthened by shortening the tubes. The furnace was the best part of the boiler for steam-generating purposes, then came the combustion chamber and the tubes. Although of the least account, the heating surface of the tubes was generally present in extra large amount. In some boilers it was as much as twenty-six or twenty-eight times the grate area, while in others it was only sixteen times the amount of grate surface—the latter proportion being equally as efficient as the former. Taking it per indicated horse-power in the first case it was 3 square feet, and the other only 2 square feet. The total heating surface was often thirty or thirty-two times the grate surface, while in the other boilers it was only twenty-two or twenty-three to one, with the same amount of economy.

At this stage, the author gave a great mass of particulars in regard to the boilers of no fewer than six steamers, with which he was intimately and professionally acquainted, the details referring to such matters as the measurements of boilers, their grate surface, tube surface, number of tubes and furnaces, the relations of the various parts to each other, and to the indicated horse-power, the consumption of fuel, &c. He then proceeded to speak of the use of high-pressure steam.

He remarked that steam at higher pressures than those most common on board of ordinary merchant steamers at the present time were, according to some persons, more economical as the pressure increased, but in what ratio that was the case, a few had dared to venture a statement. Theoretically, the value was beyond dispute, but the troubles arising from a mechanical point of view had kept engineers and shipbuilders from adopting the use of such steam pressures generally. Up to 100 lb. pressure there appeared to be very few difficulties to overcome at the present time. Some few years ago it was thought that 60 lb. was sufficient for the ordinary purposes, and that it was folly to go beyond that pressure. The troubles were—loss from leaking high-pressure pistons, cutting of valve faces, difficulties in making and keeping boilers tight, expenses of repairs, &c. ; and it was urged that the age of a boiler depended on its working pressure—that when the pressure was 60 lb. the boiler would not last so long as one working at 30 lb., although in each case the margin of safety would be the same when the boilers were new. The author's own personal experience would make him believe that the boiler of the present day working at 100 lb. pressure would, with careful attention, be as good a boiler, and as able for its work, with the same amount of safety, after six or eight years' work, as a boiler working at 30 lb. would be under the same circumstances. His own observations regarding high-pressure steam warranted him in saying that, as the pressure increased, so would the economy of fuel. The total units in steam at 109 lb. pressure, and, consequently, very little coal would be required to heat or raise steam from 30 lb. to 100 lb. pressure.

After illustrating this point at some length, Mr. Hamilton went on to remark that the patentee of Perkins's boiler had affirmed that it took no more fuel to keep up steam at 1000 lb. than was required to maintain it at 1 lb ; it took more to make it, but no more to keep it up when once made. That was the source of the principal portion of the economy in the future, and it should not be lost sight of.

To meet the requirements for the generation of such high-pressure steam, the tubular boiler had been resorted to, and tried in the steamers *Fairy Dell*, *Marc Anthony*, *Montana*, *Dakota*, and *Propontis*, with however, anything but a successful issue. The boiler of the *Fairy Dell*, on her third voyage, broke down, and as the vessel was then helpless, she foundered, and took down with her some of her crew. The *Marc Anthony* also made a voyage or two, but latterly the boiler broke down, thus rendering her helpless by the engines stopping, when she fell into the trough of the sea and foundered.

The *Montana* broke down on the way from the Tyne to Liverpool, and for fully thirty-six hours she was helpless in the Channel; but by hard struggling she eventually managed to reach Portsmouth. She subsequently attempted a sea voyage, but failed, and the owners at once resolved to take out the boilers and substitute others of the common form. It was difficult to say why the owners were tempted to use tubular boilers, as the pressure employed was only 100 lb.; and as the boilers were set in some hundreds of tons of brickwork, they were no lighter than those by which they were replaced. Next came the *Propontis*, working at 150 lb., with about the same amount of success as the others, causing the owners to remove them and substitute the common type of boilers. The main cause of the failure in the boilers referred to was the burning of the lower tubes, which was chiefly, though not wholly, caused by the absence of proper circulation, an important element in design which was entirely overlooked in every case.

Nearly three years ago Mr. J. F. Flannery read a paper before the Institution of Naval Architects on high-pressure steam, in which he said that it was an axiom laid down by theory and confirmed by practice, that the higher the pressure, with increased expansion, the greater the degree of economy. In the discussion that followed, Mr. Macfarlane Gray said that to double the present efficiency of 80 lb. it would be necessary to have steam at 1280 lb. His line of argument, said the author, was singular, and had the usual tone of that gentleman's proclivities for opposition. It was as follows:—The expectations which some engineers entertained regarding the economy of fuel by using high-pressure steam had been the main cause of the introduction of the tubular boiler; but he held quite an opposite opinion to the high-pressure steam theory. Mr. Alfred Holt, than whom no man in the world had greater knowledge practically of what had been done by steam, and by coal, and by engines, stated that the Board of Trade ought to allow shipowners increased pressure. If enquiry was made of those persons who had to pay for coal and work the steamers it would be found that all could be said was that the engines had, within the last 25 years, increased the horse-power obtained from a given quantity of coal from 5 to 8. Dividing the increase into steps, the first step was the introduction of surface condensers, which increased the power from 5 to 6. Then there was the increase of pressure from 25 lb. to 40 lb., and subsequently to 65 lb. on the boiler and 15 lb. on the atmosphere. If shipowners were allowed by the Board of Trade to employ higher pressures they could at once double the economy. Mr. Hamilton subsequently spoke of combustion in connection with the generation of steam. As generally understood by the engineer, that process was, under ordinary circumstances, the rapid combination of carbon, hydrogen, or other combustibles with oxygen at a sufficiently high temperature. Engineers differed about the quantity of air necessary to be supplied to a furnace to burn 1 lb of coal, the stated amount varying from 200 to 600 feet. But taking the average quantity at 200 cubic feet per 1 lb of coal, that showed in some measure what a large quantity of air was required to keep steam in some of our large steamships. The heat of that air before entering the furnaces would be raised by the temperature of the surrounding atmosphere of the stokehole; and were the stokehole was very warm, and the means for providing a constant supply of air defective, the fires were generally very sluggish in their action, which was the consequence of imperfect combustion. The result of that was shortness of steam to keep the engine at their required power, although the smoke in large quantities might still be visible That was one reason why the author advocated large furnaces and airy stokeholes, under which circumstances the coal would be consumed with more economy. He held also that the use of long furnace bars was not economical as the use of short ones, because the openings at the furnace mouths would only admit a certain quantity of air, which if distributed over furnace bars 4 feet long, would be more beneficial than the same quantity of air, distributed over furnace bars 6 feet long; and the smaller the diameter of the furnace, the length of the bars should be diminished in proportion. On looking into a 33 inch furnace, very likely black soot would be found, whereas in a 4 feet furnace very probably the crown would be found quite white—thus showing that combustion was more perfect in the larger furnace.

Returning to the high-pressure tubular boiler, the author said that Mr. Perkins had tried some very extensive experiments with steam at 500 lb pressure, with a considerable amount of success. At first he met with a great many difficulties, such as valve faces cutting and wearing, pistons cutting and wearing from want of lubrication, all of which he had now overcome by adopting a special metal of his own, which required no lubrication whatever. The economy which he had said he had arrived at was something never before got, namely, 1 lb. of coal per indicated horse-power per hour. This boiler was constructed of small 2¼ inch tubes with a very large furnace, and the whole cased in with sheet iron and 4 inches of non-conducting vegeteable charcoal. By that arrangement there was practically no radiation, and doubtless much of the economy was due to the means adopted to prevent the radiation of heat. But the auther was enable see how circulation could be kept up in such a form of boiler. Want of proper circulation was much against the steaming capabilities of the round boiler, and also against its durability. After a few remarks about plans that had been devised to induce circulation and to prevent priming, the paper was brought to a close.

LAUNCHES AND TRIAL TRIPS.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the MARINE ENGINEERING NEWS as complete and reliable as possible, and will thankfully receive all such information or accounts of any novelties relating to any branch of the marine engineering trades. *To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.

ENGLISH.

On April 5th there was launched from the iron shipbuilding yard of Messrs. Mounsey and Foster, at the South Dock, Sunderland, the *Mercedes*, an iron screw-steamer:—Length between perpendiculars, 285 feet 6 inches; breadth, 34 feet 10 inches; depth in hold, 24 feet; class 100 A Lloyd's; gross register about 2,150 tons. This vessel, being the fourth which Messrs. Mounsey and Foster have completed to the order of the owners, Messrs. Adamson and Ronaldson, of London, is intended for the Atlantic and general trade, and is fitted with tanks throughout, containing over 400 tons of water ballast, iron main deck, four steam winches for discharging cargo, Emmerson and Walker's patent windlass, and all the most recent improvements. She is rigged as a brigantine, her lower masts being of iron, and is built with full poop for captain and passengers, long bridge amidships with house below, containing accommodation for officers, and topgallant forecastle for crew. The engines, of 250 horse-power nominal, are to be supplied by Messrs. Blair and Co., of Stockton-on-Tees.

On April 7, a new iron screw steamer, named the *Bellingham*, was launched from the yard of Messrs. A. Leslie and Co., Hebburn-quay. Her dimensions are:—Length, 260 feet; breadth, 34 feet; depth, 23 feet 6 inches; 2,500 tons, and to be classed 100 A 1 at Lloyd's. She has been constructed on the three-decked principle, and will be fitted up in the most complete manner for employment in the Indian, American, Black Sea, and Baltic trades. The engines will be of 160 horse-power nominal, and will be fitted by the North-Eastern Engineering Company, Sunderland. The vessel is the property of Messrs. James Turpie and partners, North Shields.

On the 8th ult there was launched from the the Wear Shipbuilding-yard, Sunderland, by Messrs. S. P. Austin and Hunter, a screw steamer of the following dimensions:—Length between perpendiculars, 225 feet; breadth extreme, 31 feet; depth of hold, 16 feet. She has a long raised quarter deck, bridge house, and topgallant forecastle, is fitted with three steam winches and Harfield's patent windlass, and all the latest improvements. Her engines of 120 horse-power nominal, are by the North-Eastern Marine Engineering Company, (Limited), Sunderland. She is built to the order of a London firm. As the vessel left the ways she was named the *Medway*, by Miss Warder, of Cowes.

On April 8th there was launched from the shipyard of Messrs. Raylton, Dixon and Co., the *Viceroy*, the first of two steamers building to the order of Messrs. E. Harris and Co., of Middlesborough. They are 178 feet long; 25 feet 6 inches beam, and 14 feet depth of hold. They have long raised quarter-deck, as well as main deck of iron; water ballast in fore and aft holds, three steam winches on deck, and engines of 70 horse-power amidships. They will carry about 750 tons of cargo on 14 feet draught, and will be schooner rigged.

On April 8 there was launched from the shipbuilding-yard of Mr. Robert Thompson, jun., of Southwick, an iron screw steamer of the following dimensions, viz.:—Length over all, 318 feet; breadth extreme, 36 feet ; depth of hold, 25 feet 6 inches ; about 2,490 tons gross ; and 1,640 tons nett register, and will carry about 3,300 tons. The vessel has been built to the order of Messrs. John Glynn and Son, Liverpool, and under Lloyd's special survey to class 100 A 1. Her engines are on the inverted direct-acting compound surface-condensing principle, with 37 and 68 and 42 stroke, by the North-Eastern Marine Engineering Company, of this town. She has three decks, two being laid, of iron, also long poop, bridge, and forecastle, connected by means of gangways, and an iron wheel and charthouse on bridge. She is of a somewhat novel style, being specially built for the American cattle trade, and is to be fitted with the latest improvements in ventilation, having 12 ventilators for up and down draughts ; has four holds, water ballast in after holds and main hold, and trimming tank in fore peck, also ample fresh water accommodation, and large condenser. The cabin is fitted up aft with Captain's and spare berths, the bridge house amidships with large galley and berths for accommodation of Officers, Engineers, and cattle men, and the forecastle for Seamen and Firemen. She has four steam winches, one of which is worked by friction, and extra large horizontal donkey boiler, patent midship steering apparatus, by Messrs. Clarke, Chapman, and Gurney, of Gateshead, and patent screw gear aft ; also Harfield's Baxter patent windlass, and all the most recent improvements throughout. As the vessel left the ways she was christened the *Milanese*, by Mrs. Edmonds, wife of the Rev. C. Edmonds, of St. Peter's, Bishopwearmouth.

On the 8th of April there was launched from the yard of Messrs. John Plumer and Co., North Dock, Sunderland, a steamer built by them for Messrs. Peacock Brothers. She is of the highest class at Lloyd's (100 A), of the following demensions :– Length 240 feet; breadth, 34 feet ; depth 18½ feet ; will carry 1,900 tons ; engines by Mr. John Dickisson, compound surface-condensing of the newest type, with cylinders of 29½ and 55 inches diameter and 36 inches stroke. She was christened the *Ash* by Mrs. Willcox.

On April 8, the *Irene Morris*, a new steamer, was launched from the yard of the Whitehaven Shipbuilding Company. The vessel which belongs to Mr. John Morris, of Liverpool, and is intended for the Mediterranean trade, is 260 feet long, 33 feet beam, and 22 feet deep. Her tonnage is 1,450 tons gross, and 925 tons register. She is a screw and is schooner-rigged, with a high poop deck and bridge. The ceremony of naming the vessel was performed by Miss Irene Morris, the daughter of the owner, who gave her name to the vessel. It is intended to fit the vessel with engines of 150 horse-power, from the establishment of Messre. Jones Brothers, Liverpool.

On the 9th of April a new race yacht of 150 tons burthen, built by Mr. E. Boutcher, was launched from the building-yard of Messrs. Camper and Nicholson, at Gosport, the ceremony of naming being performed by Miss Boutcher. The new yacht is named the *Fiona*, has extensive cabin accommodation, and she is classed A 1 at Lloyd's for 17 years.

On the 10th of April, a screw steamer was launched from the Jarrow shipyard for Mr. O. L. Eichmann, Hamburg, and was named the *Otto Eichmann*, by Mrs. Fotherhill, Newcastle. The demensions of the vessel are :—Length, 230 feet ; breadth, 33 feet ; depth, 17¼ feet ; carrying capacity, 1,600 tons ; engines, 120 horse-power ; highest class at Lloyd's ; and fitted with Price's patent self-trimming hatches.

On the 10th April, a large new steamer, named the *G. W. Ward*, was launched from the yard of Messrs. Schlesinger, Davis and Co., Wallsend. The vessel, which has been built for Messrs. Ward and Holzapfel, Newcastle, Dimensions ;—Length over all, 256 feet ; breadth, 32½ feet ; depth, 21 feet 2 inches. Her carrying capacity will be 2,000 tons, and she has been classed 20 years at Liverpool. Her engines, which will be of 150 horse-power, will be supplied by Messrs. T. Clark and Co., Elswick. The vessel is intended for the Mediterranean and Indian trades, and will be commanded by Captain A. Dunn, of Sunderland. The ceremony of naming was performed by Miss Clark, Newcastle. The vessel has been specially built for the Mediterranean trade, being single decked, and carrying a large cargo with a light draught and at a very small register.

On the 19th April, Messrs. William Gray and Co., West Hartlepool, launched an iron screw steamer, built to the order of Messrs. Coverdale, Todd and Co., of West Hartlepool, Her dimensions are :—Length between perpendiculars, 256.6 ; breadth, 34.6 ; depth of holds, 10.9 and 24.3 ; gross tonnage, 1,720, and will carry a deadweight of 2,250 tons ; class 100 A 1, the highest class in Lloyd's ; engines 150-h.p., by T. Richardson and Sons. She is built with complete double bottom for water ballast, raised quarter deck, long bridge, topgallant forecastle for Crew, iron partition, all fore and aft, in centre of ship, which will effectually prevent grain cargo shifting. She is fitted with powerful steam winches, steam cranes, steam windlass, and all the latest improvements for the rapid loading and discharging of cargo. As she left the ways she was christened the *Mennythorpe*, after a village near Malton, by Miss Rosa Mary Todd, daughter of C. S. Tood, Esq., of Greatham.

On the 21st April there was launched from the iron shipbuilding-yard of Messrs. Mounsey and Foster, at the South Dock, Sunderland, an iron screw steamer named the *Winfred*, of the following dimensions :—Length, 291 feet ; breadth, 34 feet 6 inches ; depth in hold, 24 feet 9 inches. Class 100 A at Lloyd's. Gross register about 2,150 tons. This vessel will be driven by engines of 210-horse power nominal, supplied by the North-Eastern Marine Engineering Company (Limited) South Docks. Sunderland. She is built with double bottom for water ballast, and clipper bow, and is to be rigged as a three-masted schooner, her lower masts being of iron. Four steam winches for discharging cargo are fitted on the iron upper deck, also Emerson and Walker's patent windlass and other improvements. The ceremony of naming was performed by Mrs. Foster.

On the 22nd April, Messrs. Edward Withy and Co. launched, from Middleton Shipyard, Hartlepool, on iron screw steamer, built to the order of Messrs. Palgrave, Murphy and Co., of Dublin. This vessel is No. 80 in the Builders' yard, and was named the *City of Dublin*, by Miss Withy. Her principal dimensions are 230 feet by 31 feet by 16 feet 2 inches, and she has long full poop, topgallant forecastle, water ballast in both holds and under machinery, and is fitted with four steam cranes and one steam winch. She has accomodation for 14 first-class passengers, will have a Board of Trade passenger certificate, and be classed 100 A 1 at Lloyd's. Messrs. T. Richardson and Sons, of Hartlepool Iron Works, will supply a pair of compound surface condensing engines of 150-horse power, which, it is expected, will give a speed of 11 knots. The City of Dublin will be commanded by Captain J. Walsh, the senior Captain of the Owner's fleet.

Another New York Liner for Messrs. Thos. Wilson, Sons, and Co., has been launched by Farle's Shipbuilding and Engineering Company (Limited), this being the fifty-second vessel that has been built by the same company for these shipowners. Although the hour was so early, several ladies and gentlemen were present, and the launching ceremony was gracefully performed by Mrs. Rutter, wife of Captain Rutter (Messrs. Wilson's marine superintendent), being named by her the *Salerno*. Mr. and Mrs. Cameron, Mr. and Miss Duncan, Mr. Godfrey, Mr. H. S. Broderick (general manager), Mr. Pratten, Mr. Cole, and other officers of the company were also present. The launch was most successful, and, although at the time the wind was extremely high, the tugs soon brought the ship into the company's tidal dock, where those who had witnessed the launch saw the foremast, already slung in the shears, stepped in its place. The company then partook of breakfast, after which the usual toasts were proposed. The following are the general particulars of the vessel :—Length between perpendiculars, 289 feet ; breadth, 35 feet ; depth of hold, 25 feet ; gross register tonnage, about 2,100. She is a similar steamer to the Lepanto, Otranto, Sorrento, and Rialto, and, like them, is specially fitted for the New York trade, having all superstructures on deck of iron, and iron fore-and-aft bulkhead in the main and after hold for grain cargoes. The engines, which also have been made by Earle's Company, are single-crank, compound, surface-condensing, of 160 nominal horse-power, having two cylinders 26 inches and 58 inches diameter, by 4 feet 9 inch stroke, placed one above the other. The piston rods are united at one main crosshead, from which motion to the pumps as well as the crank is given. The steady working of the engines, and prevention of racing at sea, is ensured by a heavily-balanced fly-wheel on the crank shaft. Steam of 80lbs pressure is supplied by two single-ended cylindrical boilers placed athwartships. So compact is the arrangement of the machinery that only 28 feet of the ship's length is occupied by the engine and boiler rooms. Messrs. Wilson have already found this type of engine most economical and suitable for Atlantic work. Another New York liner for this firm is on the stocks, and about half framed.

The *Avenger*, an iron ship of the following dimensions. was recently launched from the yard of the Whitehaven Iron Shipbuilding Company :—Length, 252 feet ; breadth, 37 feet ; depth of hold, 22 feet ; register tonnage, 1,380 tons ; nett tonnage, 1.405. She is intended for the Australian trade, and was built for Messrs. Grice, of Bootle.

On the 22nd April, Messrs. M. Pearse and Co. launched from their iron shipbuilding yard, at Stockton, an iron screw steamer of the following dimensions, viz. :—Length, 215 feet ; extreme breadth, 32 feet ; depth of hold from top of floors to upper deck, 16 feet 6 inches. This vessel has a gross measurement of about 1,100 tons, and a carrying capacity of 1,400 tons deadweight cargo, and is classed 100 A 1 at Lloyd's, and has iron decks throughout. She is fitted for water ballast in both holds, and is supplied with Emerson and Walker's latest patent windlass; also with three powerful double-cylinder steam winches, together with all the other latest appliances for loading and discharging cargoes expeditiously, Her engines, which are of 110-horse power nominal, are from the works of Messrs. Blair and Co., Stockton.

On April 22nd there was launched from the shipbuilding-yard of the Tyne Iron Shipbuilding Company, Willington Quay, an iron screw steamer, named the *Lord Collingwood*, of the following dimensions :—Length, 270 feet; breadth, 34 feet; depth, 24 feet. The engines, which will be fitted with all the latest improvements, will be 170-horse power, and will be fitted by Messrs. R. and W. Hawthorn, of Newcastle. She is fitted with Messrs. Donkin and Nichols' patent steam-steering gear. The Lord Collingwood is 1,770 tons gross register, and is classed 100 A 1 at Lloyd's. She has been built to the order of Messrs. C. Tully and Co., and will be commanded by Captain Fenwick.

On April 23rd, there was launched from the Shipbuilding Yard of Messrs. W. H. Potter and Son, Liverpool, the Screw Steamer *Whimbrel*, built for the Cork Steam Ship Company, for their Liverpool and Ghent trade. The steamer measures 186 feet over all; length between perpendiculars, 180 feet by 28 feet beam; depth of hold, from ceiling to underside of deck, 13 feet 9 inches. Schooner rigged, fitted with water-ballast. Built under special survey to class A 1 at Lloyd's; constructed throughout of steel (Liemen process). Steam cranes, winches, and auxiliary boiler complete. The engines, of 100 nominal horse-power, with steel boiler, manufactured by Messrs. Jack and Co., Victoria Engine Works, Liverpool. The hull and machinery constructed from the designs, and under the superintendence of F. C. Kelson, consulting engineer, Liverpool.

SCOTCH.

On March 27, Messrs. Birrell, Stenhouse and Co., launched from their shipbuilding-yard, Dumbarton, an iron sailing ship of about 1,450 tons nett register, built to the order of David Law, Esq., Glasgow. The ceremony of naming her the *David Law* was performed by Miss Law, of Glasgow. This ship has been built under special survey to class 100 A 1 at Lloyd's, and will immediately proceed to Glasgow to load for Rio Janeiro, under the command of Captain Allan.

On March 28th, Mersrs. Wingate and Co., of Whiteinch, launched a screw steam dredger, named *Faugh-a-Ballagh*, of about 400 tons lifting power per hour, fitted with compound surface condensing engines, about 300 indicated horse-power, and capable of dredging to about 27 feet under water. After the launch the dredger was taken into the builders' tidal dock to be fitted with machinery. She is fitted with one row of buckets working through well in centre of hull, the buckets and machinery generally being similar to those of the Devonport dredger, now finishing by this firm for the Government. The *Faugh-a-Ballagh*, with four hopper barges, nearing completion by same firm, will form dredging fleet for Dundalk Harbour.

On March 29th, the *Malvina*, a steamer which will form one of the fleet of the London and Edinburgh Company, of Leith, was launched by Messrs. James and George Thomson, Clyde Bank. The *Malvina* is 1,300 tons and 250-horse power.

On April 4, Messrs. John Reid and Co., launched the first of three paddle steamers. The dimensions are :—Length, 125 feet; breadth 15 feet; depth 6 feet. The tonnage is 60 register and 96 gross. The vessels are intended for traffic on the River Seine, the Owners being a French firm. The fittings include a cabin aft, ladies' cabin and a large deck house which will be fitted up with a bar in French fashion. Messrs. Walker, Henderson and Co., Glasgow will supply the engines.

The first Government steamer built at Messrs. Key's shipbuilding yard, Kinghorn, Kirkcaldy—if not the first vessel built to the order of the Government in the Firth of Forth—was successfully launched on April 5th. Arrangements were made for launching the vessel nearly a fortnight ago, but owing to a sudden change in the weather the launch had to be postponed. The weather on Saturday was everything that could be desired, and thousands of people assembled in the vicinity of the yard to witness the launch of the vessel, which has been built specially for Her Majesty's Indian Government for cable service in the Persian Gulf. The dimensions of the vessel are as follows :—Length, 226 feet; beam, 30 feet 6 inches; depth in hold to main deck, 17 feet 8 inches; do. to poop, 24 feet 8 inches; gross tonnage, 1,120. She is built to Lloyd's highest class, to which several additions have been made by the Admiralty for securing the greater safety of the ship. The vessel has an ordinary raking stem and an elliptic stern, the bow and stern being fitted with large sheaves and shields for laying and picking up cables, which, although needful, do not improve the appearance of the vessel. The poop deck is over 130 feet long, and fitted up with state-rooms, dining cabins, mess-rooms, baths, &c., for the use of the large staff of officers, with provision for a number of passengers to be taken by the vessel to places where no regular service is maintained. The crew are berthed in the 'tween decks forward. Full forecastle is open, and fitted up with pens for sheep and pigs, and fowl coops. For stowing the cables, four large water-tight tanks are built in the vessel, varying from 23 to 28 feet diameter, with water-tight cones in the centre about 8 feet diameter, which are fitted to hold fresh water. Provision is made by two tanks in the bottom of the vessel for 170 tons of water ballast to preserve the trim of the ship when cables are paid out. Separate piping is laid to each cable and water ballast tank and the other compartments in the ship. One large engine capable of throwing 150 tons per hour is fitted to ballast tanks, a separate engine being fitted to fill and empty the cable tanks. All the exposed decks of the vessel and deck fittings are of teak. For the working of the vessel all the latest and most approved of patents have been brought into requisition, including the electric light, which is intended to facilitate the picking up of buoys at night, and to assist in the navigation of narrow passages. The engines are inverted compound direct-acting, 530 indicated horse-power; 28 inches cylinders, and 54 inches by 33 inches stroke. Telegraphs and voice tubes are fitted between the engine-room, bridge deck, wheelhouse, and forecastle—the telegraphs being repeating both for engine and steering purposes. After an impressive religious service conducted by the parish minister, the Rev. Mr. Dobie, Kinghorn, the vessel was gracefully christened by Mrs. Col. Champain, the *Patrick Stewart*, after the pioneer electrician, who rendered great service to his country in India. The launch was a most successful one, the vessel leaving the yard amidst the cheers of 4,000 spectators, the band of the Kinghorn Artillery Volunteers appropriately striking up, "Rule Britannia" as she glided into the placid waters of the Firth of Forth. She is manned by a crew of sixty Lascars, who, with several of the officers, were on board in uniform. The vessel was immediately taken in tow for Kirkcaldy, where she will be completed and got ready for sea. A large number of ladies and gentlemen afterwards repaired to the spacious loft in front of the yard, where cake and wine were amply provided, and where "Success to the *Patrick Stewart*," "The Health of the Builders," and several other toasts appropriate to the occasion were given. These proceedings were of a most interesting description, and were taken part in by Sir William Merryweather; Lieutenant-Colonel Champain, of the Royal Engineers; Provost Swan; Captain Stiffe, commander of the vessel; and others.

On the 9th of April, Messrs. A. M'Millan and Son launched from the dockyard at Dumbarton the screw steamer *Cosmo*, of 1,550 tons register. This vessel, which has been built to the order of Messrs. Tellefsen, Wills and Co., of Cardiff, is fitted with a poop and amidship houses (for the accommodation of a few passengers and the Officers and Engineers of the vessel). Built altogether of iron, her main or second deck is also entirely of iron, and all her fittings are of the strongest description. She has a double bottom in her afterhold, and under the boilers, and a large tank in forehold capable of holding in all over 400 tons of water ballast. The naming ceremony was performed by Miss Minnie Tellefsen, daughter of the principal Owner.

On April 9th Messrs. A. M'Millan and Son launched from the Dockyard at Dumbarton the screw-steamer *Cosmo*, of 1,550 tons register. This vessel which has been built to the order of Messrs. Tellefsen, Wills and Co., of Cardiff, is fitted with a poop and 'midship houses (for the accommodation of a few passengers and the officers and engineers of the vessel). Built altogether of iron, her main or second deck is also entirely of iron, and all her fittings are of the strongest description. She has a double bottom in her afterhold, and under the boilers, and a large tank in forehold capable of holding in many tons of water ballast.

On the 10th inst., Messrs. H. M'Intyre and Co., launched from their shipbuilding-yard at Paisley, the *Cyprus*, an iron screw steamer of 700 tons burthen. Her dimensions are :—Length, 176 feet; breadth, 25 feet 6 inches; and depth of hold, 13 feet 3 inches. She is built to the order of Eugene Collins, Esq., M.P. for Kinsale, and has an iron main deck all fore and aft, patent windlass and steering gear, and all the best appliances for loading and discharging cargo. She will be fitted with compound surface condensing engines by Messrs. Muir and Houston, Glasgow. She was named by Miss Rebecca Loundes, Crosslee, Thornliebank.

On the 11th April the *Alpha*, the first steamer ever built at Thurso, was launched there. The vessel has been constructed to the order of Messrs. Miller and Leith, of Wick, and is to employed in the fishing. She is 67 feet in length, 16 feet 2 inches of beam, depth of hold 8 feet, and was built by Messrs. M'Kenzie and Gunn.

On April 12th there was launched from the shipbuilding yard of Messrs. Caird & Co., Greenock, a paddle-steamer of the following dimensions :—Length, 200 feet ; breadth, 22 feet 4 inches ; depth (moulded), 16 feet ; tonnage (gross), 500 tons. She is fitted up with oscillating compound engines, and has been built to the order of Messrs. Knowles and Foster, for the Bahia Steam Navigation Company. Her passenger accommodation is suitably adapted for the climate in which the ship will trade. Her name is *Marinho Visconde.*

On the 19th April Messrs. Scott and Co. launched, from their shipbuilding yard at Cartsdyke, a screw steam yacht of the following dimensions :—Length, 170 feet ; breadth, 21 feet 2 inches ; depth, 13 feet 1 inch ; gross tonnage, 254. The new vessel, which was named the *Ulva*, has been built to the order of Mr. F. A. Hankey, Royal Yacht Squadron. She will be fitted with compound engines of 70 horse-power by the Greenock Foundry Company. The boiler, which was immediately after the launch put on board at the crane in the Victoria Harbour, is fitted with the Leeds' Forge Company's corrugated furnaces.

On April 22nd Messrs. John Reid and Co., Shipbuilders, Port Glasgow, launched a 20-ton yacht, built for Mr. G. W. Richardson, Greenock, and named *Sayonara.* She is after the model of the *Florence.* The hull is composite, the frames being steel.

On April 23rd the fourth steamer built by Messrs Alex. Stephen and Sons, for the new Clan Line, was launched from the yard at Linthouse, and named *Clan Lamont*, by Mrs. Charles Lamont, Glasgow. The *Clan Lamont* is a steamer of about 2,200 tons, classed 100 A 1, with compound surface condensing engines of 250 horse-power nominal, the machinery being all on board before launching. The vessel is fitted with the best modern improvements, and has passenger accommodation all on deck.

UNITED STATES.

Four steamships, wholly of iron, are now building on the Delaware, at Chester, Pennsylvania. The largest of these is for Mallory's New York and Texas line. It will be 321 feet long, and of about 3000 tons burden. The vessel is 20 feet longer than the *Rio Grande* of the same line, and will have six watertight compartments, double decks and beams, and be fitted with compound engines. The next largest vessel is one for Alexandre's Sons' New York and Havana line, and will be in every respect like the *City of Washington* of the same line, conceded to be the fastest ocean steamer afloat, except that she will be 10 feet longer. She will be 310 feet long, with three iron decks beside the hurricane deck. seven water tight compartments, and compound of engines of 2000 horse-power. The other steamship is for Ward's New York, and Havana line, and will be a sister ship to the *Niagara*, of the same line. She is 294 feet long, with 38 feet beam, 23 feet depth of hold, 2265 tons, double iron decks, five watertight compartments and compound engines.

TRIAL TRIPS.

A few days ago a cargo steam-launch was tried in the River Mersey. She was built by Messrs. Thomas Brassey and Co., from the designs and specifications of Mr. H. C. Ashlin, of the firm of Ashlin and Ashbridge, consulting engineers, &c., and to the order of Messrs. A. and M. Hershell, African agents, of this town. This vessel has been specially designed to carry casks of palm oil on the River Volta, on the West Coast of Africa. As this river has a very rapid current, and in places is exceedingly shallow, it has been necessary to float this vessel on a very light draught of water, and at the same time to obtain a high rate of speed ; this has been done by economising weight in every possible form consistent with strength and durability, both in the hull and machinery. One of the chief features in this vessel is Turner's patent multitubular boiler, the particular advantages claimed for it being lightness, combined with strength and durability, easy access to all parts for inspection, safety from accidents, all strains being in tension ; it has all the advantages claimed for a water-tube boiler, yet being in every respect a multitubular steam generator. The vessel, which is built in two watertight halves, for the convenience of shipping on board the mail steamers to Africa, is 11 feet long, 9 feet 6 inches beam, load draught of water 3 feet. She is fitted with a pair of high pressure engines of 13½ nominal horse-power, working at a steam pressure of 80 lbs. per square inch ? and on her trial the vessel obtained an average speed of nearly twelve knots per hour, the engines indicating above 100 horse-power, and from the particulars taken the consumption of coal is very light, being about half the quantity anticipated ; at the same time the working pressure of 80 lbs. being maintained without priming, the total heating surface being proportioned as in an ordinary boiler, viz., 230 square feet)17 feet per nominal horse-power). This very satisfactory result is in a great part attributable to the peculiar construction of the furnace and firebox, and the majority of the heating surface being in the thin metal of the tubes. The greatest satisfaction was expressed at this result both by the owners and the party of practical gentlemen who were present during the trial ; and as the result of this (the first boiler of the kind that has been made) has been so satisfactory, will, undoubtedly reccommend isself to steamship owners and other steam users, when they consider that the weight, cost, and consumption is little more than one half of the ordinary marine boiler. This vessel, the *Bagieda*, is the first of this particular class, combining weight, carrying, towing power, and speed on such light draught of water, and the result must be exceedingly satisfactory both to her designers and constructors.

The steel despatch vessel *Iris* made, under the superintendence of Captain Wells and Mr. Charles Icely, of the Portsmouth Steam Reserve, a trial on April 6th, of her capstan gear and steam-steering apparatus. She went out of harbour in the morning to Spithead, being steered by hand, and then anchored for the purpose of testing her Harfield capstan. About 100 men were employed at the staves, and the time taken to weigh anchor was a little over an hour. In the mean time the hand appliances had been disconnected, and the Forrester steam-steering gear having been converted, the ship was steered from the forward and the after bridge. There was a little slipping at first, but this was soon corrected, and the machinery was found to answer very well. The engines were afterwards worked at full speed, and when seventeen knots had been reached the *Iris* was made to circle to port and starboard, the time occupied in completing the circles being 6½ minutes, the diameter being no less than 1,000 yards. On Thursday night the Wilde electric lights, with which she is provided at each end of the bridge, were tried at the dockyard, and were found in perfect order and to illuminate a wide radius.

On the 7th ult. the *Celtic Monarch*, built by Messss. Wigham, Richardson, and Co.. at Walker-on-the-Tyne, for the Royal Exchange Shipping Company, to the order of Messrs. Patton of London, made a very successful half-loaded trip from the Tyne to sea. She attained a speed of 10½ knots per hour. She subsequently proceeded the same evening to London to load for China and Japan.

On April 8th the new steamer, *Dodo*, from Messrs. Cunliffe and Dunlop's yard ran her trial trip on the measured mile at Skelmorlie and made 10½ knots, giving every satisfaction. She afterwards proceeded to Glasgow to load, and will then proceed to Liverpool. The *Dodo* is owned by the British and African Steam Navigation Company, and is intended for river traffic on the West Coast of Africa.

The steamer *Abana* which has just been completed by Messrs. M. Pearse and Co., iron Shipbuilders, at Stockton, had her trial trip on the 10th April. The vessel is 310 feet long, with 36 feet beam, and a depth of 26 feet 8 inches. She is three decked, with two iron decks laid, and is fitted for water ballast in both holds. The register tonnage of the ship is 2,400 tons gross, with a carrying capacity of 3,200 tons, her class being 100 A 1 at Lloyd's. Messrs. G. Y. Blair and Co., of Stockton, have fitted the engines, which are on the compound surface-condensing principle, of 180 horse-power nominal ; and on the trial, despite the heavy sea then rolling, worked admirably. The sea on the occasion was very high, with a strong easterly breeze ; but, notwithstanding this, the steamer's capabilities as a sea boat were fully tested, and proved satisfactory to Builders and Owners, her speed being fully 10 knots. At the conclusion of the trip the steamer returned to Middlesborough for bunker coals, and then left for Cardiff to take in cargo. She is intended for the Transatlantic trade, being sold to a Liverpool gentleman. The steamer will be commanded by Captain Howell.

On the 12th ult. the new iron screw stemer *Radnor*, built by Palmer's Shipbuilding and Iron Company, (Limited), of Jarrow, for Messrs. J. and J. H. Cory, of Cardiff, proceeded to sea for her steam trial, and after satisfactory trials and adjusting compasses, she proceeded direct to Cardiff to load. She will carry 1,750 tons.

On April 22nd the steamer *Amazonense*, built and engined by Messrs. Oswald, Mordaunt, and Co., of Southampton, for Messrs. R. Singlehurst and Co., of Liverpool, had her trial trip in the Solent, which proved a most satisfactory one. The dimensions of the vessel are as follows :—Length, 297 feet ; breadth, 34 feet 6 inches: depth, 22 feet ; and she is fitted with a pair of Oswald's improved compound engines. On the trial a speed of 11 knots was attained. This vessel is fitted with one of Oswald's improved Griffith's propellers.

On April 24th the new steam yacht *Nora*, of 450 tons, built by Messrs. C. Mitchell and Co., of Walker, for M. Perret, the French Senator, went for a trial trip off the Tyne, having on board a party of gentlemen representing the builders, engineers, and owners. After having had several hours' run, and a most satisfactory trial, the engines, which had been supplied by Messrs. R. and W. Haw-

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IMPORTANT NOTICE.

The Proprietor begs to inform his many friends, patrons, subscribers and others that on and after the 2nd of June, his Journal will be called THE MARINE ENGINEER, and will contain four extra pages. Every effort will be exerted to make the Journal worthy of its title.

NOTICE.

ALL Contributions and Books for Review, should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed.

Terms of subscriptions to "The MARINE ENGINEER" payable in advance, is five shillings per annum. Post Office Orders to be made payable to W. G. Neal, of 3, Amen Corner, London, E.C., at the Ludgate Circus Money Order Office. Advertisements must be sent in not later than the 26th of each month to ensure insertion in the following number.

The Marine Engineer,

LONDON, JUNE 2, 1879.

The past month, like that which preceded it, has been marked by the assembling of one of those important institutions which combine science with industrial pursuits. Now that iron has largely supplanted wood in shipbuilding, to be supplanted, to all appearance, in its turn by steel, what passes in the meetings of the Iron and Steel Institute must be of the utmost interest to the marine engineers. Two papers directly bearing upon shipbuilding material were read at the late meeting of that society. That of Mr Adamson, the well-known pioneer of the use of steel in the construction of steam boilers, had its value, although in the combined discussion on these two essays, with that of Mr. H. R. Maynard on the use of steel in bridges, Mr. Barnaby's on the use of the same material in naval architecture almost wholly engrossed the attention of the meeting. Mr. Adamson showed very clearly that, with care in selection, steel may be expected to display nearly twice the strength and durability of iron for nearly every purpose to which either of them can be applied. Mr. Barnaby supplied a large amount of practical information regarding the manner in which steel, which has been used in the royal dockyards continuously for fifteen years past is tested and with what results; and the general outcome of the discussion was in favor of steel, excepting only in the case of chains and some other special work. The strength and endurance of steel as compared with even superior iron, and the prospect of a great reduction in its price from new methods of manufacture, such as the Thomas-Gilchrist process, afterwards laid before the institution, must eventually bring it into very extensive if not into general use.

The shipbuilding returns for 1878 issued by the Board of Trade show with the distinctness of figures what has long been apparent in half empty yards and diminished establishments. The Clyde builders, who have turned out 60 per cent. of the steam tonnage of the country, are suffering more than those of any other district; indeed, their output has been gradually diminishing from 1874, when it reached a maximum of nearly six millions sterling, to last year, when it was probably under three. On the other hand the production of the East Coast builders has latterly been proportionally greater, the falling off in the Clyde being most striking. The Board of Trade's statistics for 1878 are as follows: East Coast steamers, 299,646 tons; sailing ships 24,122; total 323,768. Clyde steamers, 131,443; sailing ships, 56,678: total 188,121. The total for the United Kingdom is, steamers, 491,515; sailing ships, 145,787: grand total, 637,302 tons.

Some interesting information has recently been published regarding the forecast received from the United States Meteorological Department indicating the direction that storms, after leaving the eastern coast of America are likely to take. The importance of such anticipatory notices, if reliable, to ships crossing the Atlantic, or, indeed, proceeding on any other voyage, cannot be over-estimated; and numbers of these predictions have actually been fulfilled, There is no mystery in the way in which the course of such atmospheric disturbances is anticipated. Most of the Atlantic storms are incubated on the American Continent and the wires which send intelligence of their rise, course and progress range over lines of four thousand miles in length. The extent and course of the cyclone can thus be exactly mapped and its probable career after it leaves the land pretty accurately estimated. Its force on reaching Europe is more difficult to predict; but the accuracy of the forecasts, in that as well as in other respects has been so great, that the warnings referred to, should to a considerable extent influence the sailing of ships from English ports.

From the annual report of the National Life-boat Institution, we learn that there are now stationed round our coasts, under the management of this praiseworthy society, 268 lifeboats, ten of which have been added during the past year; and to their crews is due the rescue of 471 persons and 17 vessels in 1877-78. Besides these services of the life-boat crews, which number in all about 12,000 persons, 145 persons have been, during the year, rescued from a watery grave by fishing boats and other means. And besides silver medals and votes of thanks inscribed on vellum, the Society has expended £2750 in money rewards. It is a pity that, under these circumstances, its income should have been allowed to fall short of its expenditure to nearly £3,000. During last year the loss of life by drowning in the merchant service alone, was at the rate of one for every 87,503 persons employed, a percentage much too high, nearly seven times the number of those who perished by accident in collieries, and three times the number of railway *employes* whose lives were cut short in the same manner.

The Darien canal project has recently entered upon a new phase, a congress of scientific and practical men having met in Paris to discuss seven distinct plans for creating a waterway between the Atlantic and Pacific, where the two continents of New World meet. The cheapest and easiest of them is sufficient to tax severely the mechanical and financial resources of the age; but should the undertaking succeed the gain to the commerce of the world will be enormous. The dangerous passage of the Horn will be avoided and the route from the Channel to San Francisco shortened by three thousand leagues, the time for sailing vessels being reduced from 60 to about 30 days. The new ship canal cut through the narrow neck of land separating the port of Amsterdam from the North Sea has given wonderful facilities to the trade of that important emporium; and that those facilities are fully appreciated by the mercantile population is evidenced by the free use that has already been made of it, which will doubtless be greatly increased when it has been deepened as is proposed. A more difficult feat of engineering was the formation of a navigable channel at the mouth of the Mississippi, which is now open for ships drawing not more than 23 feet up to New Orleans, while a depth of 33 feet is expected to be ultimately attained. M. Roudaire's proposal to let the waters of the Mediterranean into an extensive depression of the Sahara in Algeria, and the similar scheme of Mr. Mackenzie to turn those of the Atlantic into the same desert farther south and throw Central Africa open to navigation and commerce, making a seaport of Timbuctoo, are possibly practical, but are at present in abeyance; while General Fremont the Governor of Arizona is in the field with a similar proposal to admit the waters of the Gulf of California into an ancient sea basin, and create a navigable inland sea 200 miles long, 50 miles broad and 300 feet deep. Other schemes of the same kind have been broached, but the Panama business is quite enough for the present.

THE USE OF SUPERIOR IRON IN SHIPBUILDING.

Complaints have frequently been made of the readiness with which iron vessels go to pieces in circumstances where wooden ships would hold together. By using steel of suitable quality as a shipbuilding material, however, an extraordinary power of resistance is attained, as will be seen from the following instances: In October, 1875, the steamer Thorer Helsing, 1300 tons, built at Lindholmen, near Gothenburg, of Motala Bessemer steel, having on board a cargo of 1200 tons, stranded on Kullegrund, in the Baltic, the bottom being rocky, and the steamer resting upon it for a length of more than 100 feet amidships, and remaining there fourteen days, until it was got afloat after 400 tons of the cargo had been discharged. During the whole time, with the exception of two days, the weather was stormy and the sea high, the steamer being completely exposed, and during three days there raged a violent hurricane from the east, which rendered it impossible for any one to remain on board. When the steamer was got afloat on the fifteenth day it was brought to Gothenburg to discharge cargo, after which it was docked at Lindholmen.

On being examined in the dock, the bottom of the vessel was found to be bent inwards in wavy lines, stones and heights in the rocky bottom having been forced into it as into a mass of lead. Although the keel, bottom piece, and water tight compartments had bent more than six inches, there was not a single leak to be found, Both the keel, which was bent in various directions and the plates could be taken out, straightened, and replaced.

Another steamer, the Motala, built at Norrkoping, which on its way from Rouen to Pillau, ran aground on the Jutland coast, at the same place where the Russian screw frigate Alexander Nevsky was totally lost in 1869, gave the most extraordinary proof of tenacity.

This vessel was unceasingly driven hither and thither on a bed of sand and rock for five months, from the 17th February, 1875, until the 26th July when it was got afloat. When it was docked it was found that only thirty plates required to be taken out, straightened, and replaced. The stem of the vessel also required to be straightened, but in other respects it was uninjured.

The steamer Carlsund, under full steam, and with a speed of ten to eleven knots, ran upon a granite rock near Gothenburg, in 1869, but when taken off was found completely watertight, and not to have a single leak.

The steamer Norden, built at Norrkoping, ran upon a rock in the Baltic in 1869, and though a part of it about 20 feet in length was considerably bent in, not a single plate—not even a bolt—had given way. The same steamer, some years after came into collision with the steamer Juno, built of Bessemer steel, at the same place. Though, according to all appearances, a catastrophe ought to have happened, as both vessels were under full steam, they were able, after a short interval, to resume their voyage to their respective destinations. In this connection, the stem of the steamer Blekinge, which ran at full speed upon a rock, may be referred to. It was shown at the exhibition of 1862, and was afterwards placed in the Jermyn Street Museum as a remarkable illustration of the toughness of Swedish iron.

These instances are sufficient to show that the dangers which attend navigation may be reduced in an extraordinary degree by the use of the best materials in shipbuilding.

WATER-TUBE AND FIRE TUBE BOILERS.

(Continued from Page 26.)

An Account of the Experiments made by Chief Engineers Loring and Baker, U.S. Navy, on a Horizontal Fire-Tube and a Vertical Water-Tube Boiler, at the Washington Navy Yard, to ascertain their relative Economic Vaporization with different kinds of Coal.

BY CHIEF ENGINEER ISHERWOOD, U.S. NAVY.

[*From the Journal of the Franklin Institute.*]

In order that the results of the experiments should be strictly comparable, as regards the economic vaporization of water, they should have been made with equal quantities of water vaporized in equal time, which implies equal quantities of the heat produced by the fuel, absorbed by the water in equal time. This condition, however, does not obtain in the experiments as perfectly as could be desired, but the departures from it were not sufficiently wide to materially affect the comparisons, owing to the facts that the rate of combustion at the maximum was moderate, and that the heat-absorbing surface was great in proportion to the quantity of heat thrown upon it per hour.

In the case of the two experiments D and E, made on anthracite with the vertical water-tube boiler, 116,667·233 and 129,955·288 pounds of water were vaporized during the experiments from the temperature of 212 degrees Fahrenheit, on the supposition that the water was supplied at that temperature, and the economic results were respectively 13·0764 and 13·0477 pounds of water vaporized from the temperature of 212 degrees Fahrenheit by one pound of the combustible portion of the anthracite. The difference in the potential vaporization appears here not to have influenced the economic vaporization. It is undoubted, however, that to some extent—more or less, according to circumstances,—increased potential vaporization is accompanied by decreased economic vaporization but when the maximum potential vaporization is not great, and the heat-absorbing surface is great in proportion to the quantity of heat absorbed in a given time, the effect of any difference in the potential vaporization on the economic vaporization becomes sufficiently small to be neglected from a practical point of view.

For the comparison of the economic vaporizations by the horizontal fire-tube and vertical water-tube boilers, *when burning anthracite* we have experiments A and E, experiment D not being included because of its less potential vaporization. In experiment A, made with the horizontal fire-tube boiler, the economic vaporization from the temperature of 212 degrees Fahrenheit was 11·4717 pounds of water per pound of the combustible portion of the anthracite; while, in experiment E, made with the vertical water-tube boiler, it was 13·0477 pounds of water. Hence, *with anthracite*, the vertical water tube boiler, under the experimental conditions, vaporized per pound of fuel $\left(\frac{13{\cdot}0477—11{\cdot}4717 \times 100}{11{\cdot}4717}\right)$=13·74 per centum more water than the horizontal fire-tube boiler. This percentage would have been less had the potential vaporizations in the two experiments been equal.

For the comparison of the economic vaporizations by the horizontal fire-tube and vertical water-tube boilers, *when burning semi-bituminous coal*, we have experiments B and C, in which the potential vaporizations were nearly equal. In experiment B, made with the horizontal fire-tube boiler, the economic vaporization from the temperature of 212 degrees Fahrenheit was 11·5670 pounds of water per pound of the combustible portion of the semi-bituminous coal, while, in experiment C, made with the vertical water-tube boiler, it was 13·8477 pounds of water. Hence, with *semi-bituminous coal*, the vertical water-tube boiler, under the experimental conditions, vaporized per pound of fuel $\left(\frac{13{\cdot}8477—11{\cdot}5670 \times 100}{11{\cdot}5670}\right)$=19·72 per centum more water than the horizontal fire-tube boiler.

It will be remembered that with equal weights of the combustible portion of *anthracite*, the vertical water-tube boiler was economically somewhat less than 13·74 per centum superior to the horizontal fire-tube boiler, and we now see this superiority increased to 19·72 per centum for equal weights of the combustible portion of *semi-bituminous coal*. To what should this increase be attributed? The distillation of semi-bituminous coal in the furnace, previous to the incandescence of its fixed carbon, produces a very much larger quantity of combustible gases than the similar distillation of anthracite. The fixed carbon of both coals is consumed on the grate in the solid form, but the combustion of the gases takes place after their distillation, in the furnace above the fixed carbon, and in the tubes also, if heat and oxygen enough be present, *and the gases be sufficiently intermingled with the latter*. In the horizontal fire-tube there is nothing to produce this necessary intermingling; there is no obstruction, the gases pass rapidly through it in parallel streaks unmixed; but with the vertical water-tubes, the tubes themselves are mechanical mixers, standing, as they do, in and across the current of the gases. To their position, therefore, may be attributed the marked difference in the amount of their economic gain when vaporizing water with semi-bituminous coal and when vaporizing it with anthracite—the one a very gas-producing and the other almost a non-gas producing fuel. The superiority of the vertical water-tubes may be due not only to their better absorption of heat, but to their contributing to its development by their mechanical mixing of the coal-gases and the atmospheric oxygen. If these hypotheses are correct, the vertical water-tube boiler, comparatively with the horizontal fire-tube boiler, should have a greater economic superiority in the vaporization of water the more gas-producing the coal consumed.

It will be observed that the foregoing comparisons between the two boilers are for substantially equal potential vaporizations per hour or, roughly, for equal rates of combustion; but had each boiler been fired to its maximum, about fifty per centum more coal would have been consumed in the same time in the horizontal fire-tube boiler than in the vertical water-tube boiler, and with about twenty-five per centum less economy per pound of fuel, producing about twenty-five per centum more steam per hour.

As regards the relative economic efficiency of the combustible portion of anthracite and of semi-bituminous coal, *consumed in the horizontal fire-tube boiler*, a comparison of the economic vaporizations per pound of these combustible portions, given in experiments A and B, shows that the two fuels were about equal, the results being, in experiment A, 11·4717 pounds of water vaporized from the temperature of 212 degrees Fahrenheit by one pound of the combustible portion of anthracite, and 11·5670 pounds of water vaporized from the same temperature by the pound of the combustible portion of semi-bituminous coal.

If, however, the comparison be made for the pound of coal in the two cases, assuming the refuse in the anthracite at one-sixth and in semi-bituminous coal at one-eighth of the gross weight, which are the averages in practice, then the economic vaporization of water from the temperature of 212 degrees Fahrenheit per pound of coal becomes $(11{\cdot}4717 \times \frac{5}{6} =)$ 9·5598 pounds for the anthracite and $(11{\cdot}5670 \times \frac{7}{8} =)$10·1213 pounds for the semi-bituminous coal, or the latter is $\left(\frac{10{\cdot}1213—9{\cdot}5598 \times 100}{9{\cdot}5598}\right)$=5·72 per centum superior the former.

As regards the relative economic efficiency of the combustible portion of anthracite and of semi-bituminous coal, *consumed in the vertical water-tube boiler*, a comparison of the economic vaporizations per pound of these combustible portions, given in experiments E and C, shows that the pound of the combustible portion of the anthracite vaporized in experiment E 13·0477 pounds of water from the temperature of 212 degrees Fahrenheit, while the pound of the combustible portion of the semi-bituminous coal vaporized, in experiment C, 13·8477 pounds of water from the same temperature; hence, the economic efficiency of a pound of the combustible portion of semi-bituminous coal was $\left(\frac{13{\cdot}8477—13{\cdot}0477 \times 100}{13{\cdot}0477}\right)$=6·13 per centum greater than that of a pound of the combustible portion of anthracite.

If, however, the comparison be made for the pound of coal in the two cases, assuming, as before, the refuse in anthracite at one-sixth and in semi-bituminous coal at one-eighth of the gross weight, then the economic vaporization of water from the temperature of 212 degrees Fahrenheit per pound of coal becomes $(13{\cdot}0477 \times \frac{5}{6} =)$10·8731 pounds for the anthracite and $(13{\cdot}8477 \times \frac{7}{8} =)$12·1167 pounds for the semi-bituminious coal, or the latter is $\left(\frac{12{\cdot}1167—10{\cdot}8731 \times 100}{10{\cdot}8731}\right)$=11·44 per centum superior to the former.

To determine the economic efficiency of the combustible portion of the caking bituminous coal relativly with that of the combustible portion of anthracite and of semi-bituminous coal, the economic vaporization of water from the temperature of 212 degrees Fahrenheit, given in experiment F, by the pound of the combustible portion of caking semi-bituminous coal, will be compared with that given in experiment E by the pound of the combustible portion of anthracite and with that given in experiment C by the pound of the combustible portion of semi-bituminous coal, all three of the experiments having been made with the vertical water-tube boiler.

In experiment E, the pound of the combustible portion of the caking bituminous coal vaporized from the temperature of 212 degrees Fahrenheit 11·7769 pounds of water. In experiment E, the pound of the combustible portion of anthracite vaporized from the same temperature 13·0477 pounds of water. And, in experiment C, the pound of the combustible portion of semi-bituminous coal vaporized from the same temperature 13·8477 pounds of water. Hence, the economic vaporization by the pound of the combustible portion of caking bituminous coal was $\left(\frac{13{\cdot}0477-11{\cdot}7769\times100}{13{\cdot}0477}\right)=9{\cdot}74$ per centum less than by the pound of the combustible portion of the anthracite. And the economic vaporization by the pound of the combustible portion of caking bituminous coal was $\left(\frac{13{\cdot}8477-11{\cdot}7769\times100}{13{\cdot}8477}\right)$ $=14{\cdot}95$ per centum less than by the pound of the combustible portion of semi-bituminous coal.

WATER-TUBE AND FIRE-TUBE BOILERS, by Chief Engineer ISHERWOOD, U.S. Navy.

Table containing the Data and Results of the experiments made in March and April, 1873, at the Washington Navy-yard, by Chief Engineers Loring and Baker, U.S. Navy, on two Cylindrical Tubular Boilers of the same dimensions, but differing in the kind of arrangement of tubes, one having the ordinary horizontal fire-tube returned above the furnaces, and the other having vertical water-tubes returned above the furnaces. The object of the experiments was to ascertain the economic vaporization under atmospheric pressure by each boiler when burning Pennsylvanian Anthracite, a semi-bituminous coal from the Cumberland mines of Maryland, and a bituminous coal of unknown locality, under the experimental conditions.

		Horizontal fire-tube boiler.		Vertical water-tube boiler.			
		Anthracite.	Semi-bituminous coal.	Semi-bituminous coal.	Anthracite.		Bituminous coal.
	Designation of experiment ...	A	B	C	D	E	F
Boilers.	Square feet of grate surface ...	36·00	36 00	36·00	36·00	36·00	36·00
	Square feet of heating surface, calculated for the inner surfaces of the tubes ...	1019·00	1019·00	1104·00	1104·00	1104·00	1104·00
	Square feet of opening for draught over the bridge-walls ...	5·55	5·55	5·55	5·55	5·55	5·55
	Square feet of opening for draught through the tubes ...	7·24	7·24	5·55	5·55	5·55	5·55
Total quantities.	Duration of the experiments, in consecutive hours ...	30·	30·	30·	30·	30·	30·
	Total number of cubic feet of water vaporized from the temperature of the feed-water	2134·816	2061·670	2008·466	1582·830	1769·107	1888·815
	Total number of pounds of water vaporized from the temperature of the feed-water ...	133187·0	128623·6	125304·3	98749·7	110367·4	117835·5
	Total number of pounds of coal consumed...	15336·0	15168·0	12979·0	10506·0	11280·0	13317·0
	Total number of pounds of refuse from the coal in ash, clinker and soot ...	1608·0	2022·0	2284·0	1584·0	1320·0	1570·0
	Total number of pounds of combustible or gasifiable portion of the coal consumed ...	13728·0	13146·0	10695·0	8922·0	9960.0	11747·0
	Per centum of the coal in refuse of ash, clinker and soot ...	10·485	13·331	17·598	15·077	11.704	11·789
Rate of combustion.	Pounds of coal consumed per hour ...	511·200	505·600	432·633	350·200	376·000	443·900
	Pounds of combustible or gasifiable portion of the coal consumed per hour...	457·600	438·200	356·500	297·400	332 000	391·567
	Pounds of coal consumed per hour per square foot of grate surface ...	14·200	14·044	12·018	9·728	10·444	12·331
	Pounds of combustible consumed per hour per square foot of grate surface...	12·711	12.172	9·903	8·261	9·222	10·877
	Pounds of coal consumed per hour per square foot of heating surface ...	0·502	0·496	0·392	0·317	0·341	0·402
	Pounds of combustible consumed per hour per square foot of heating surface ...	0·449	0·430	0·323	0·269	0·301	0·335
Temperatures.	Temperature, in degrees Fahrenheit, of the external atmosphere ...	35·	43·	43·	30·	47·	56·
	Temperature, in degrees Fahrenheit, of the gases of combustion in the uptake ...	702·	—·	—·	338·	338·	358·
	Temperature, in degrees Fahrenheit, of the feed water in the tank ...	39·	39·	39·	39·	43·	43·
Pressure.	Steam pressure in boiler, in pounds per square inch above zero ...	17·00	16·75	16·50	16·00	16·18	16 25
Vaporization.	Total number of pounds of water that would have been vaporized had the feed-water been supplied at the temperature of 100 degrees Fahrenheit, and vaporized under the pressure of 29·92 inches of mercury ...	141008·672	136151·600	132607·757	104461·845	116359·742	123869·721
	Total number of pounds of water that would have been vaporized had the feed-water been supplied at the temperature of 212 degrees Fahrenheit, and vaporized under the pressure of 29·92 inches of mercury ...	157484·215	152059 706	148101·731	116667·233	129955·288	138342·737
	Pounds of water vaporized from 100 degrees Fahrenheit by one pound of coal...	9·1946	8·9762	10·2171	9·9431	10 3156	9 3016
	Pounds of water vaporized from 100 degrees Fahrenheit by one pound of combustible ...	10·2716	10·3569	12·3990	11·7083	11·6827	10·5448
	Pounds of water vaporized 212 degrees Fahrenheit by one pound of coal ...	10·2689	10·0250	11·4109	11·1048	11·5204	10 3884
	Pounds of water vaporized from 212 degrees Fahrenheit by one pound of combustible ...	11·4717	11·5670	13·8477	13·0764	13·0477	11·7769

STRENGTH OF CRANK SHAFTS.

IN our last number we published a paper on the Strains on Crank Shafts, read at the last meeting of the Institution of Naval Architects, by Mr. J. T. Milton, Engineer Surveyor to Lloyd's Register. The paper was very well received, and there can be no doubt of its being not only interesting, but also of considerable value as tending to throw light upon some of the causes which lead to the disablement of crank shafts of marine engines.

As stated in the paper, the crank shaft, is of all parts of marine engines, that which requires most frequent renewal, and those who have experience with the shafts of a number of steamers know that their average life is much less than that of the boilers, although the corrosion of these is looked upon just now as being the one great trouble engineers have to contend with. Although the renewal of boilers is a very expensive job, yet their decay is gradual, and so far regular that a long warning is given before they are done for and consequently arrangements may be made for fitting new boilers which do not involve unexpected detention and delay; whilst with crank shafts, in very many cases their failure is sudden, and it often has occurred that a vessel has been detained in a foreign port, until a new shaft has been made in England and sent out to her.

Amongst the causes which tend to throw great strains on shafts, the author of the paper singles out three: the presence of water in the cylinders with the relief valves inoperative, slackness of brasses, and the bearings being out of line. With regard to the first it is pretty evident that with water in the cylinder and no outlet for it something must give way, that something may be the cylinder cover or bottom, it may be a top or bottom end bolt, or it may be the crank shaft. With regard to the second cause, slackness of the brasses, this will certainly give heavy blows on the shaft, but a remedy for it is indicated in the paper, viz.: cushioning of the steam, which by reversing the direction of the pressure on the piston gradually takes up the slack without the heavy blow; and this cushioning can always be obtained by "linking up" the slide valves. The most fruitful cause of failure of shafts, is, we believe, the third, viz: bearings out of line and the importance of having the bearings perfectly true cannot be too strongly insisted upon. The effect of having the bearings the least bit out of truth is to throw more than its share of the support of the shaft upon one particular bearing, this greatly increases the bending strain on the shaft, without altering in the least the twisting strain on the journals, it also has a tendency to make the bearings heat. In calculating the effect of bearings being out of line, the author of the paper takes as a limit one of the bearings being taken away altogether, remarking that while this might be thought to be too extreme a case, it is one which really occurs in practice every time that the cap of a bearing is slacked right back, as is too often done when the bearing heats; from the calculations it appears that slacking the end bearings produces a strain on the shaft fully double that to which it is subjected when in proper order, while slacking either of the middle bearings, strains it one and a half times its proper load. From these facts it would appear that whenever it is absolutely necessary to so slack a bearing as to take away its support from the shaft, the engine ought at the same time to be slowed down, so that there should not be such a great load on the crank pins. It was remarked by Mr. Ravenhill during the discussion, that he had no doubt that many an engineer, after reading this paper would be able to account for a flaw in his shaft which had first been observed after having a hot bearing and running some time with its cap slacked right back and at the same time going full speed.

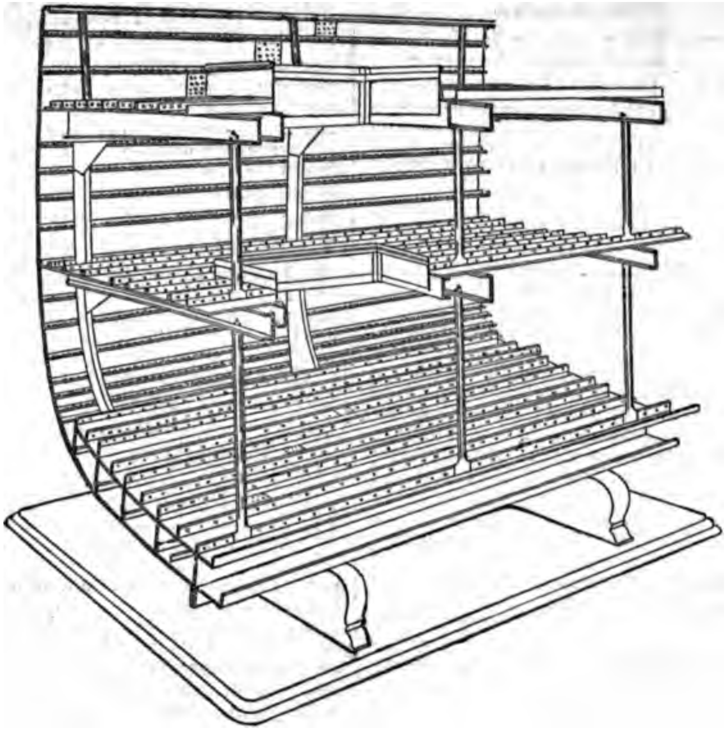
Mr. A. C. Kirk in a very brief speech, made a valuable suggestion as to the mortality of shafts. While fully concurring with the author of the paper that the bearings being out of line throw great strains on the shaft, and giving it as his opinion that the bearings should be tested as to their lineability at least once a year, instead of, as is too frequently the case, waiting until their untruth gives positive trouble; he also stated that he considered in many cases that the shafts of engines are made too small to bear the repeated strains to which they are incessantly subjected; remarking that if a shaft of a certain size would last, say one year, if it were made a little larger it would probably last 3 or 4, and if larger still, would practically last out the engines. The view taken by this gentleman corresponds with the result of some experiments made by the late Sir William Fairbairn, on the strength of wrought iron girders. These experiments shewed that wrought iron may be subjected an unlimited number of times, to a load equal to one-fourth of its breaking weight under a steady strain, without any apparent influence on its strength, whilst a load of one-third of its ultimate strength was sufficient to produce rupture after 313,000 repetitions, and a load of two-fifths of the ultimate strength produced rupture after only 5,175 applications of the load.

As bearing directly upon this opinion, it was stated by Mr. Maginnis, that a large steamship company kept a record of the number of revolutions run by the crank shafts of their steamers, and that it was found that the average was from 80 to 100 millions. If a few of the large steamship companies would record, and publish the average number of revolutions run by crank shafts, and at the same time carefully calculate, not only the maximum strain per square inch, borne by the shafts in their regular running, but also the variation of strain during each revolution (for it is evident that a very variable load is much more severe than a steady load of even greater intensity than the maximum), they would confer a very great benefit to the engineering profession.

THE DILLON SYSTEM OF RAISING SUNKEN VESSELS.

ON Thursday morning, the 22nd of May, His Royal Highness the Duke of Edinburgh, honoured Mr. Thomas A. Dillon with a visit at his rooms, at the Westminster Palace Hotel, to inspect the latest development in his system of raising sunken vessels by the aid of compressed air. His Royal Highness was attended by Captain Clarke, Equerry in waiting, and was received by Colonel Sarsfield Greene, C.B., Royal Horse Artillery, and Captain Codrington, R.N. There were present on the part of the Admiralty, Admiral Sir Houston Stewart, K.C.B., Controller of the Navy, and Mr. Barnaby, C.B., Director of Naval Construction. The First Lord was unavoidably absent having been summoned to attend a Cabinet Council. The French Government was represented by Count de Montebello, Minister Plenipotentiary, and Principal Secretary of the French Embassy, the Marquis de la Ferronays, French Military Attaché M. Shilling, French Naval Attaché, and M. de Kergolay and M. de Savigny, Secretaries to the French Embassy. The Dutch Government was represented by the Count de Bylandt, the Dutch Ambassador, and Mr. May, Consul-General for Holland. There were also present Dr. Siemens, F.R.S., Mr. Edge, M.P., Major O'Gorman, M.P., Mr. Gray of the Board of Trade, and Mr. G. Lindo, as well as Mr. Robert P. Spice, the President, and Mr. Perry F. Nursey, the Secretary of the Society of Engineers, of which Mr. Dillon is a member. The invention consists in a method of causing sunken vessels to rise and float without the aid of divers, and without in any way touching the ship. This is effected by certain pneumatic and hydrostatic laws, which have hitherto been either unobserved or neglected but which Mr. Dillon has laid under contribution in the attainment of his desired end. The principle consists in surrounding the vessel to be raised by an air-tight bell of tent-like construction, which is floated and lowered over the vessel by means of simple mechanical appliances. The water is then displaced from beneath this bell, and at the same time from out of the ship, by means of compressed air. When a sufficient amount of water has been displaced the bell rises to the surface, and with it, strange to say, comes the ship, although not in any way supported or touched by the bell. This is the essential and distinguishing feature of the latest development of a system of ship-raising upon which Mr. Dillon has been engaged for several years past. The system was explained in detail, and its working illustrated by a number of experiments by the inventor to his royal and distinguished visitors, who, on taking their leave, expressed themselves highly gratified with this ingenious and promising invention. Mr. Dillon pointed out the desirability of applying his system to the raising of the *Vanguard* without loss of time. It was conceded that the experiment would be one of national and universal importance, and it was stated that the Admiralty intended removing the masts of the vessel.

THE NEW EDDYSTONE LIGHTHOUSE.—The Trinity Board announces that their Royal Highnesses the Duke and Duchess of Edinburgh will lay the foundation stone of the new Eddystone Lighthouse. The day fixed is that of the lowest spring tide, when the rock at one o'clock will be thoroughly bared, and the Princess, if the weather be fine, can land upon the site to lay the stone.



MECHANICAL SHIPBUILDING. HUMPHRYS' PATENT.

ON A SYSTEM OF MECHANICAL SHIPBUILDING,

BY J. HUMPHRYS.

[*Read at the Institution of Naval Architects.*]

I have endeavoured to make the paper I am about to read to you as brief as possible, trusting that the models and plans I have laid before you will supplement my description, so as to render my meaning qute intelligible.

Ever since I have been connected with shipbuilding, I have been very much impressed with the peculiar feature which attaches to it, viz., that the builder should be almost entirely dependent on skilled manual labour, and whereas we find in most other important manufactures that there has been a constant aim to minimise skilled manual labour, and cheapen and improve the workmanship by the introduction of mechanical appliances, little, so far as I know, has been done in this direction as regards shipbuilding.

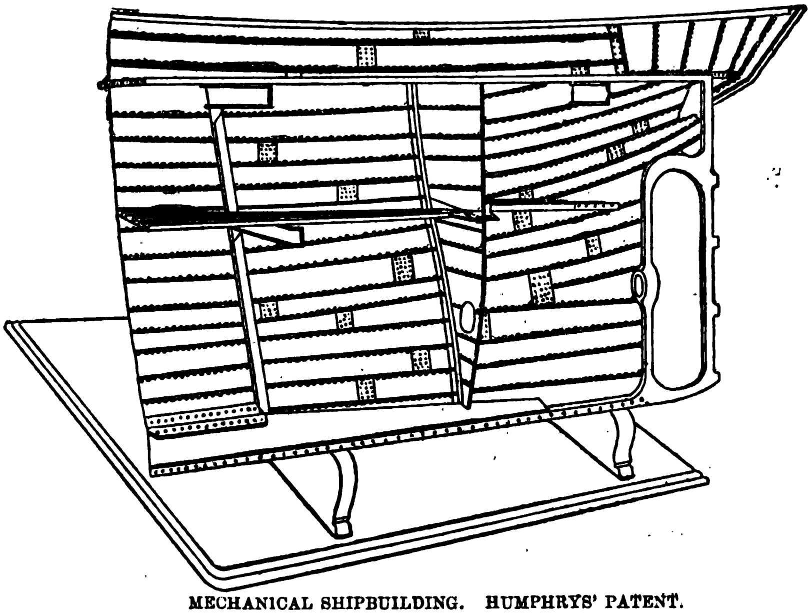
The reason, I think, is obvious. Iron shipbuilding grew directly from wooden shipbuilding, the methods of construction being very similar; in both there is the skeleton framework, consisting of keel, keelsons, frames, stringers, beams, &c., on which is laid the skin, in the one consisting of wooden planking, and in the other of plating. This has been the received mode from time immemorial, and is as I may say, grafted into the nature of all naval architects, and from its very arrangement it is almost impossible to bring to bear any mechanical contrivances to aid the builder, such as are met with in almost all other important manufactures.

Now to trace very cursorily the way in which an ordinary iron ship is constructed, we find that the designer's lines are projected to the natural size on a floor, that the angle irons forming the frames and reverse frames are placed into long furnaces, heated, and bent by skilful workmen to these lines; the floor-plates and beams are similarly dealt with; these parts are then taken to the place in the building-yard where the vessel is to be erected, they are fastened together, usually by hand rivetting, are then erected on loose wooden blocks fixed in position, and shored by means of rough poles, ribbands. and stages; the skeleton is then faired and tied together with the keelsons and stringers, and lined off for the skin plating, all this work being dependent on the skill of shipwrights, and requiring constant care and adjustment to counteract subsidence and keep the structure fair; then comes the plater with his wooden templates, which are marked off from the skeleton and transferred to the plates, which are marked and afterwards punched (the accuracy of every hole being dependent on the skill with which the plater and his assistants can manipulate the plates under the punching-press); the plates are next set, and then hung on the skeleton, and the rivetting is proceeded with, which is all affected by hand labour.

This method of construction, has, I believe, hitherto defied all attempts to bring mechanical appliances to bear satisfactorily except to a very limited extent, such as, for instance, the rivetting of the frames, floors, and beams by mechanical rivetters.

Shipbuilding is, therefore, perhaps more than any other manufacture, except the building trade, placed at a disadvantage in relation with its workpeople, and this may be the reason why we find, I believe, a greater number of labour difficulties in these trades than in any other.

When we consider the vast importance of the shipbuilding trade, and the enormous sums which are annually expended in this country for the building of ships, you will, I think, admit that it is a matter of the first importance that, if practicable, shipbuilding should be to a much greater extent than at present



MECHANICAL SHIPBUILDING. HUMPHRYS' PATENT.

assisted by appliances, and so be placed on a footing somewhat similar to that of, say, marine engine or locomotive building.

It occured to me, therefore, that as the present mode of construction appears to present insuperable difficulties in this direction, it might perhaps be possible to devise a novel method of construction by which, in a great measure, the dependence of shipbuilders on skilled manual labour might be lessened: and what I propose is a longitudinal mode of construction (which is generally admitted to be stronger than the present ordinary mode, but hitherto being considered too costly it has seldom been adopted), the material to be used to consist of channel sections, the flanges and other parts being so arranged that the rivetting which connects the fabric together may be readily effected by mechanical rivetters.

I propose that the process of building shall be carried out as follows. A permanent building-shop consisting of strong and rigid frames erected at regular intervals in the direction of its length, and braced together longitudinally, covered by a suitable roof, and somewhat in accordance with the plan exhibited, is to be built on a firm foundation, the whole forming a perfectly rigid framework capable of sustaining the weight of the ship. In these frames I would fix suitable packings made up to the exact transverse sections of the ship at the various stations, and on these packings I would inscribe offsets representing the points where the connecting flanges would meet each other: the particulars could be readily obtained by projection on the mould floor. A skeleton mould or cradle representing the form and lines of the vessel would thus be formed in which the ship could be built without risk of subsidence or loss of form.

A system of cranes could be conveniently arranged above, from which the mechanical rivetters could be carried (and if on the hydraulic principle they could be in communication with a hydraulic main and accumulator for working them).

I propose that there should be a number of the channel sections varying in sizes and thicknesses, and which might be described as No. 1, No. 2, No. 3, &c., &c. A code of rules could be framed similar to Lloyd's tables, from which could be ascertained the weights of the various sections required in the construction of any given size vessel, such size to be based, say, on the under deck tonnage, &c., &c.

This would offer many advantages. The shipbuilder would be enabled to order the material required for a ship immediately on receipt of an order by referring to the table (it takes from two to four weeks under the present system to do this), and there would be little or no waste in the form of scrap as against a loss of 5 to 7 per cent. as at present. The maker would merely have to roll the sections and cut them to fair lengths (just as in rolling rails); he could also roll to stock, and so afford to put in the rolls for any section at any time, by which also a considerable saving of time would be effected; and considering the large quantities that would be required for shipbuilding, I have reason to believe, from communications on the subject with ironmasters, that these sections could be produced as cheaply as the materials used in the present mode of shipbuilding.

The sections on delivery at the shipbuilder's works could be at once passed through self-acting punching machines, the holes made with the utmost rapidity, all holes being at a uniform distance from the edge, and precisely equidistant from each other, and the distance between the planed butt and the centre of the last hole being exactly half the distance between the centres of two holes, all the holes when the sections were fitted together would be absolutely fair, and the rivets being fastened by hydraulic or often approved mechanical rivetters would exactly fill the holes, and so make the soundest work. For a considerable portion of the ship the sections would require no setting whatever as they possess sufficient elasticity to admit of a considerable amount of twist or "sny" which would be obtained simply by securing them in the cradle. The number of drop plates, and those requiring special working, is but small, as may be seen from the models, and from the the experiments I have made I am convinced there would be no difficulty in dealing with them in a thoroughly satisfactory manner.

The sections as prepared, would then be laid in the cradle, their edges being placed so as to coincide with the offsets inscribed on the transverse sections, as described previously; the keelsons would be placed in position, and the mechanical rivetters could be at once applied and the connection of the fabric proceeded with; the structure being built up from the bottom and completed as the work advanced. so effecting a very considerable saving in time as compared with the the present system, by enabling other trades to follow more rapidly. A water-tight double bottom could be very readily formed by the proposed system, and would be, I think, far more reliable than the water ballast bottoms as at present constructed.

The cost of labour would be very greatly reduced, as the furnacing and setting of frames, reverse frames, and floors would be dispensed with, and a great saving would be obtained in a large portion of platers'work, particularly punching, templating, and setting; and of shipwright's work in shoring, staging, and ribbanding, all risk of subsidence and loss of form (necessitating at present care and attention) being obviated by building in the rigid cradle; and sound and cheap mechanical rivetting would be substituted for expensive hand rivetting, which I fear is not always so faithfully done as it should be.

I think there would be also a decided advantage to the manufacturer of the material by its being confined to a certain number of recognised sections, and that they could be rolled much as rails are. All these considerations would result in a great rapidity of construction, which in a large vessel might amount to two or three months' less time than at present required.

I have had two midship sections prepared, one being that of the steamers built by the Barrow Shipbuilding Company for the Ducal Line, which are of 3,000 tons gross register. and 380 feet between the perpendiculars, 38·3 feet beam extreme, and 28·6 feet depth in hold, the other of a vessel of the same dimensions to be constructed on the channel section system. I have made the thickness of the skin in the latter the same as that in the Ducal Steamers, and in both cases only the hull proper is dealt with, irrespective of deck, houses, &c.; the weights have been most carefully calculated from this midship section, and amount to 1390 tons, whereas the weight used in the Ducal Steamers was 1410 tons, showing a small reduction in weight, but by the channel section principle a complete and water-tight double bottom is obtained, which does not exist in the other, and the fabric is constructed on a longitudinal system, which I am convinced is far stronger than the existing mode on which the Ducal Steamers were built.

In the very important matter of repairs also the proposed system offers some advantages, as every vessel so constructed might always carry with her a few plates, which being punched to a uniform guage could be readily fixed to replace a damaged plate or plates, the only labour required being to cut out the defective part, put in a spare plate or plates, and rivet together, platers not being required.

I have had this matter under careful consideration for nearly two years, and feel convinced the proposed system of construction will afford many and great advantages to all concerned in shipbuilding; and although doubtless, as in all new things, some unforeseen difficulties may arise, I do not think they will prove such as may not readily be overcome, and that they will be as nothing when compared with the many advantages presented, which offer, especially from a commercial point of view, such great desiderata; and if the system be adopted. I have little doubt that the skill and experience which, others may bring to bear on it will rapidly lead to improvements and refinements, and that a fabric so constructed may become as superior to that I have ventured lay before you as the present iron ship is to those of earlier types.

THE STRUCTURAL ARRANGEMENTS AND PROPORTIONS OF H.M.S IRIS.

By Mr. W. H. White, Assistant Constructor of the Navy, Member of Council.*

THE use of mild steel as a substitute for iron in shipbuilding is now attracting so much attention that some interest will probably be felt in the brief description of the structural arrangements of H.M.S. Iris which is given in this paper. It is well known that this vessel was the first, built in England, in which mild steel was employed, and that she was the first vessel of the Royal Navy wholly built of steel. Notwithstanding her exceptional character, as compared with other types of war ships or with merchant ships, it may be well to put on record in the "Transactions" the facts as to her scantlings and structural strength; for while she differs from most seagoing ships in many particulars, she illustrates, I think, some principles of construction that are applicable to all steel-built vessels.

It is necessary at the outset to sketch the general features of the design. The principal dimensions are as follows:—Length between perpendiculars, 300ft.; breadth, extreme, 46ft.; depth, from upper deck, at side amidships, to under side of bar keel, 28ft. 4½in.; mean load draught, 19ft. 9in.; corresponding displacement, 3735 tons. Mr. Wright has given in his paper a full account of the propelling machinery, and the remarkable steam trials of the ship. I need not repeat the description here. The diagram shows in outline the manner in which the hold-space is occupied and subdivided No less than 138ft. of the length is occupied by engines, boilers, and coals. There are two separate stoke-holds and two engine-rooms. The engines and boilers are kept below the water-line, and protected throughout by wing coal-bunkers, varying in thickness from 5ft. to 8ft. between the upper and lower decks, and decreasing in thickness as the depth below water increases. There are ten complete watertight transverse bulkheads; and in wake of the stokeholds, where the main bulkheads are 44ft. apart, intermediate, or "partial," bulkheads are introduced in the coal-bunkers. The longitudinal bunker bulkheads are also watertight; and throughout the length occupied by the machinery and boilers there is a watertight inner skin, forming a complete double bottom across the ship between the bunkers. Before and abaft the double bottom a watertight platform is built, about 7ft. below the lower deck and extended to the bow and stern respectively. This platform does not extend quite to the foremost boiler-room bulkhead, because the small "fore-hold"—about 14ft. in length—is nearly occupied with water-tanks and chain-lockers. In the coal-bunkers also, there is a platform about mid-height between lower deck and bilge. As is usual in her Majesty's service, the magazines and other enclosed spaces are formed into watertight compartments, and altogether there are no less than sixty-one separate compartments, twenty-one in the hold proper, and forty in the double bottom and bunkers. The various partition bulkheads just mentioned of course contribute largely to the structural strength, especially to the transverse strength; and this must be kept in view when examining the framing. In some respects the system of framing adopted in the Iris resembles that commonly used in iron vessels of the Royal Navy, but in other respects it is novel. It may be said that the arrangement of the framing has been governed by the desire to efficiently stiffen and support the comparatively thin skin-plating, while avoiding the use of closely spaced transverse frames. The skin-plating is ¼in. thick, with a doubled sheer-strake; the garboard strakes are ½in. Throughout the length of the double-bottom the transverse frames are spaced 4ft. apart; before and abaft the double bottom the spacing is 3½ft. By means of the longitudinal framing the unsupported spaces of the bottom plating are kept down to 16 or 20 square feet, and buckling or unfairness is prevented. As regards the framing in wake of the double bottom, the outer or frame angles are $6 \times 3 \times \frac{7}{16}$; they are made continuous from the first longitudinal on one side to that on the other, passing through scores cut in the centre or vertical keel-plate, and are again continuous from the upper deck down to the second longitudinal. Up to the turn of the bilge, the transverse frames below the inner skin are on the well-known "bracket-plate" system, the brackets being formed of $\frac{5}{16}$in. plates, and the short angles on their inner edges being $6 \times 3 \times \frac{3}{8}$ between the keel and second longitudinal, but only $3 \times 3 \times \frac{7}{16}$ between the second and third longitudinal, where a lightened plate is substituted for a bracket. Within the coal-bunkers the reversed frames are $3 \times 3 \times \frac{7}{16}$; the centre-plate keel is ⅜in. thick, with lightening holes in the spaces between the frames; its lower edge is rivetted to the bar keel (iron). The longitudinals in the double bottom are formed of $\frac{5}{16}$ in. plates, with $3 \times 3 \times \frac{3}{8}$ bars on the outer edges, and $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{5}{16}$ bars on the inner edges. Plates and bars are worked continuously, with butts carefully shifted and strapped, in the same way as is usually done in armoured ships. The first longitudinal out from the keel on each side is made watertight throughout the double bottom. In wake of the bunkers the light transverse framing is well stiffened by the lower deck stringer, and by the platform below the lower deck; besides which there are longitudinals formed of $10 \times 3\frac{1}{2} \times 3\frac{1}{2} \times \frac{7}{16}$ Z-bars, similar to those now used for frames behind armour in ironclads. These Z-bars are scored in over the 6in. frames, and secured to the skin-plating, a continuous $3 \times 3 \times \frac{3}{8}$ angle-bar being worked inside the reversed frames, and rivetted to them and to the Z-bars. A strong and simple stiffener is thus secured with very little workmanship. Outside the limits of the double bottom, the framing closely resembles that described for the coal-bunker spaces, with the addition of a floor-plate, and a gutter-plate at the middle line. Care is taken to scarph-on the Z-bar longitudinals before and abaft the double bottom, to the deep longitudinals within the double bottom. The plates of the longitudinals are gradually reduced in depth, and a strake of the inner bottom is extended over the tapered portion of the longitudinal, to strengthen the connection. The inner bottom plating is $\frac{5}{16}$in. and ¼in. in thickness; the edge joints are single rivetted, and butts double rivetted. It is worked flush, as is usual in ships of the Navy. Its vertical continuations, forming the coal-bunker bulkheads, are ¼in. plating, with $3 \times 3 \times \frac{3}{8}$ vertical stiffeners placed 30in. apart. This plating is lapped, and single rivetted at the edges, the butts being double rivetted. The coal-bunker bulkheads are continuous, the transverse bulkheads being cut off where the two systems cross one another. This is a departure from common practice, but has obvious advantages. For nearly one half of the length of the ship, where all the principal strains have to be resisted, and where the largest hatchways have to be cut in the decks, the ship's sides are constructed strictly on the cellular system, the inner and outer skins being stiffened independently, as well as strongly connected to each other by the horizontal plating on deck and platforms, and by the vertical transverse bulkheads. The desire to provide coal protection for the engines and boilers was the primary cause of this arrangement, but it might probably be imitated with advantage in other classes of ships. The outer bottom plating, up to some distance above the bilge, is worked in the usual manner with double chain-rivetted lap joints. Above this height the plates are flush-jointed at the edges, with continuous single rivetted internal strips; this is purely for the sake of appearance. The butts are all secured by double-chain rivetted straps. It may be proper to state here that Staffordshire iron rivets are used throughout the ship, the sizes being the same as would be used with iron plates of the same thicknesses, but the pitch being reduced slightly in the butt fastenings to secure sufficient shearing strength. This was preferred either to using larger iron rivets, and consequently having heavier straps and laps, or to using steel rivets. Respecting the transverse and other bulkheads in the hold, it will suffice to say that the usual practice is followed in construction; the plating is ¼in. and $\frac{5}{16}$in. thick, with vertical stiffeners $3 \times 3 \times \frac{3}{8}$ placed 30in. apart. Single rivetted lap joints are used in this work.

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* Read before the Institution of Naval Architects.

Considerations of durability are really paramount in the determination in the minimum thickness of plating that can be used in most of these partitions, and the gain by substituting steel for iron is comparatively unimportant.

There is nothing in the deck framing which needs to be described, but it may be interesting to summarise the arrangements of the deck plating:—Upper deck: A partial steel deck (⅜in.) on each side, about 8ft. wide amidships, forming a top to the coal bunker; before and abaft the bunkers this plating is gradually tapered to a stringer about 4ft. broad. Lower deck: A stringer plate, 30in. wide and ⅜in. thick. Platforms: Before and abaft double bottom (watertight) ¼in. plating; in coal bunker, $\frac{5}{16}$in. plating. The butts of all the longitudinal tie-plating are carefully strapped and double-chain rivetted. The framing of the extremities calls for very few remarks. A bar-stem (iron) is used, and the bow framing is of the ordinary character. At the stern the only unusual features are consequent upon the extreme fineness of form. In order to decrease the labour of building, and the volume of internal spaces required to be filled in with cement, the bar-keel is ended about 30ft. before the sternpost. The true keel from that point is really a flat plate turned upwards, and carried along about 6ft. above the height of the under side of bar-keel produced. The space between the flat keel and the base line is made good by means of an external centre plate, having double angle irons on the upper and lower edges, and wood chocks bolted to the sides, with frequent bracket stiffeners in steel.

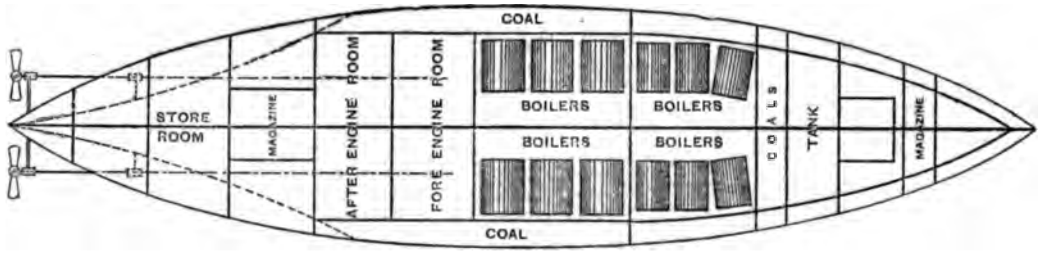
In the Iris, owing to her great power and fine form, the length of external shaft tubes is about 50ft. Each tube is supported by two struts or A-frames; and the attachment of these to the hull has been satisfactorily arranged with only trifling additions to the framing proper. Under the very severe and repeated tests consequent upon the long series of steam trials, there has not been the least indication of weakness or want of rigidity at the after part or indeed any part of the ship. Another illustration of the possibility of meeting great local strains by comparatively small, but judiciously applied additions to the ordinary framing, is supplied by the engine bearers of the Iris.

It is now about two years since the Iris was launched at Pembroke. She has not yet been tried at sea, but in trials under way, repeated dockings, and under various conditions to which a ship is subjected while incomplete in a dockyard, she has shown herself perfectly successful in resisting local strains. As to her capacity for resisting the principal strains to which a ship at sea is subjected, there can be no question. Her transverse strength is, as has been shown, exceptionally great. As to her longitudinal strength, the following facts may be stated: When floating in still water she is subjected to hogging moments throughout her length. The maximum hogging moment in still water is 19,000 foot-tons, or about equal to one-fifty-eight of the product of the displacement by the length. To this bending moment there corresponds a maximum tensile strain on the upper deck of 2½ tons per square inch. Further, if the Iris is supposed to be balanced instantaneously on the crest of a wave of her own length—300ft.—and 15ft. high, her conditions of strain become modified. The maximum hogging moment is then 38,000 foot-tons—one-twenty ninth of the product of displacement in length. To this bending moment there corresponds a maximum tensile strain on the upper deck of about 5 tons per square inch, or less than one-fifth of the ultimate strength of the material. This is an eminently satisfactory result. The neutral axis for hogging is about fifty-two-hundredths of the depth of the ship amidships below the upper deck at the side, so that the compressive strains on the bottom do not exceed a maximum of 4·6 tons per square inch. It is interesting to notice in passing that the maximum hogging moments of the Iris in still water and on the wave crest bear to one another a ratio differing from that of the corresponding moments for any ship subjected to hogging strains only in still water, of which the curves of weight, buoyancy, &c., have yet been published. Comparing her with the **Minotaur**, for example:—

			Maximum hogging Moment.
In still water	**Minotaur**	...	**× displacement × length ÷ 80**
	Iris	...	**„ „ ÷ 58**
On wave crest	**Minotaur**	...	**„ „ ÷ 28**
	Iris	...	**„ „ ÷ 29**

It is not necessary to discuss the differences in the distribution of weight and buoyancy, and in the forms of the ships which produce these results, as the corresponding curves for the Minotaur are before the public.

The Iris is now practically complete, and her weight of hull has been ascertained. It amounts to about 38½ per cent. of the load displacement, all the fittings being included. On investigation it is found that the saving effected by using steel instead of iron may be said to be about 12 per cent. on the weight of hull, or about 175 tons. This saving renders possible a large propor-



PLAN OF H.M.S. IRIS.

tionate addition to the coal supply. The distribution of the weights in this vessel is as follows, when expressed as percentages of the displacement:

	Per cent.
Hull	38·5
Rigging, armament, stores, and general equipment	13·5
Engines, boilers, &c.	28·
Coals	20·
	100·

The percentage for weight of hull will probably seem high to gentlemen conversant only with merchant ship construction; and it may be well to remark that in a war ship, carrying guns and torpedoes, minutely, divided into watertight compartments, and elaborately fitted throughout with reference to her special service, a large amount of weight is charged to the hull to which there is nothing corresponding in the merchant ship. The fairest method of estimating the saving of weight effected by using steel is, therefore, that I have adopted—comparing the Iris with another iron-built war ship of nearly the same dimensions and displacement. But it may be interesting to add that, in looking through the details of weights for the Iris, I find that over 200 tons of materials have been worked into the hull for fittings, subdivisions, &c., not required in a merchant ship; and if this weight be deducted, the hull absorbs only about 32 per cent. of the displacement; and it could be built, no doubt, with that weight of sufficient strength.

As a matter of interest only, illustrating the vastly different conditions under which a torpedo boat is driven at a speed equal to that of the Iris, the following table is given:—

Hull	38	per cent. of the displacement.
Equipment and coals	22	
Engines, boiler, &c.	40	
	100	

To drive the Iris at her full speed of 18·6 knots on the measured mile, about 2·3 indicated horse-power per ton of displacement were required. In the torpedo vessel, over 14 indicated horse-power per ton are expended. The Iris is a sea-going ship, fully equipped, and capable of steaming nearly 7000 knots, at a speed of ten knots, on her own coal supply; but the torpedo vessel is in no sense sea going, and carries only a limited coal supply and equipment. The Iris gains upon the torpedo vessel in these various particulars, chiefly because of her much greater size; but when she is compared with other fast sea-going steamships, her size is very moderate and her speed is much in excess, in consequence of which the expenditure of power in proportion to displacement is unusually great. This statement is not likely to be questioned by anyone familiar with steamship design. The length of the Iris is also very moderate when considered in relation to her maximum speed; but it is necessary to remember that she has absolutely no *straight of breadth* amidships, and consequently has as great a length of entrance and run as many mechant steamers 80ft. or 100ft. longer than herself. This is, no doubt, much in her favor when steaming at speeds approaching her maximum. No sea-going merchant steamer having realised the measured-mile speed of the Iris, I cannot illustrate the matter by comparing their performances with hers. But turning to Mr. Froude's paper "On the Comparative Resistances of Long Ships," in the "Transactions" for 1876, and having regard to the experiments on the model of the Merkara, built by the Messrs. Denny, a comparison may be made between her probable performance, if driven at eighteen knots by twin screws, and that of the Iris—eighteen knots being about the full speed which the Iris may be expected to attain when fully laden. For a speed of eighteen knots, Mr. Froude gives—

Resistance of Merkara ... ... = 70,000lb.
Corresponding effective horse-power ... ... = 3,870.H.P.

This is for the naked hull. If she had twin screws, the external struts and tubes would cause an increased resistance, which would, however, be more than counterbalanced by the greater efficiency of the twin screws. Using our data for the Iris in order to pass from the net effective horse-power of the Merkara to her probable indicated horse-power for eighteen knots, I find that the ships compare about as follows, when the Merkara is brought to the actual load displacement of the Iris:—

Merkara (probable)	8,500 I.P.H.
Iris (actual)	7,500 ,,

At the measured mile the Merkara attained thirteen knots with 2000 indicated horse-power, when driven by a single screw; and the Iris, although of 690 tons less displacement at her trial draught—3980 tons as against 3290—required about the same power for an equal speed. It is of course necessary to remember that the engines of the Iris were then developing less than one-third of their full power; but allowing for this, the figures now given illustrate the influence which the length of entrance and run have upon the expenditure of power at high speeds, and show that absolute length, if obtained by middle body with only moderate lengths of entrance and run, may not be a source of economy at very high speeds. Mr. Froude has fully stated the case in his paper published in the "Transactions" for 1877. I have referred to it only as bearing upon the dimensions chosen for the Iris.

In determining upon the dimensions and proportions of the Iris, it was necessary to consider not merely possible economy of engine power, but her special requirements as an unarmoured war-ship. The chief requirements additional to those of speed and coal endurance were—(1) Protection of the engines and boilers, by placing them under water and within the side coal-bunkers. (2) Provision of sufficient initial stability to enable the vessel to be safely navigated when her consumable stores were exhausted, or when compartments have been bilged in action. (3) Moderate length, to secure handiness. These special requirements, and her unusually high speed, completely separate the design of the Iris from that of the swiftest ocean-going merchant steamers, and render it practically useless to endeavour to argue from one class of ship to the other. No one at the Admiralty could be disposed to recommend that the forms and proportion of the Iris should be imitated on a larger scale in the merchant service. Nor, on the other hand, does it seem probable that a swift despatch vessel, fulfilling the above requirements, could be built satisfactorily on the model of the existing merchant steamers, having say, ten beams in the length. These proportions are, no doubt, well adapted for merchant steamers carrying heavy cargoes, with centres of gravity low down in the ships, and freely using water or other ballast to preserve their stability. But in a vessel like the Iris, the vertical distribution of the weights is very different; and if an armed despatch vessel were built on the merchant steamer model, of the same displacement as the Iris, but with, say ten beams in the length, I am of opinion that sufficient initial stability could only be secured, even in the load condition, by using ballast. This is the conclusion I have reached after a careful consideration of the particulars of many successful ocean steamers with which I have been favoured by various gentlemen. Furthermore, to the best of my judgment it seems certain that the economy of steam power in the longer and narrower despatch vessel would be comparatively small, even if any were obtained, as compared with the Iris. Any savings in weight of machinery that might be made in the new vessel would I think, be much more than counterbalanced by the weight required for ballast, and the additional weight put into the hull, if this vessel were to be made as strong and as stable as the actual Iris. It may be said that the Iris is unnecessarily strong against principal strains, or that she is unnecessarily "stiff" against heeling forces. In reply, I need only say that with a few exceptions—such as the upper deck plating—the provision against local strains and for minute water-tight subdivision, as well as for a reasonable amount of wear and tear, has regulated the scantlings chiefly, and caused the strength against principal strains to be so ample. Moreover, taking into account the differences between merchant-ship and war-ship construction mentioned above, and the increased strains incidental to the adoption of greater lengths and greater ratios of length to breadth, I am inclined to believe that it would be no easy matter to build a new and longer Iris with a less weight of hull than that of the existing ship, and with sufficient strength. As regards subdivision and "stiffness," it is clear that in a ship intended to be capable of fighting, there must be a margin against loss of stability through compartments being damaged by gun-fire or ramming, which may reasonably be dispensed with in a merchant steamer. A minor difficulty that would have to be faced in a narrower and longer ship of equal displacement with the Iris would be the stowage of the hold. This would require to be entirely rearranged as compared with the Iris, if the engines and boilers are to be kept under water; and accepting the possibility of doing this by occupying a greater length with the machinery and boilers, it will be evident that coal protection equal to that in the Iris could only be given to the longer ship by carrying a greater weight of coal. The greater length of side to be protected necessitates this, or the acceptance of a less thickness of bunker if the same weight of coal is carried as in the Iris.

NEW PORTABLE STEAM RIVETTING MACHINE FOR SHIPS.

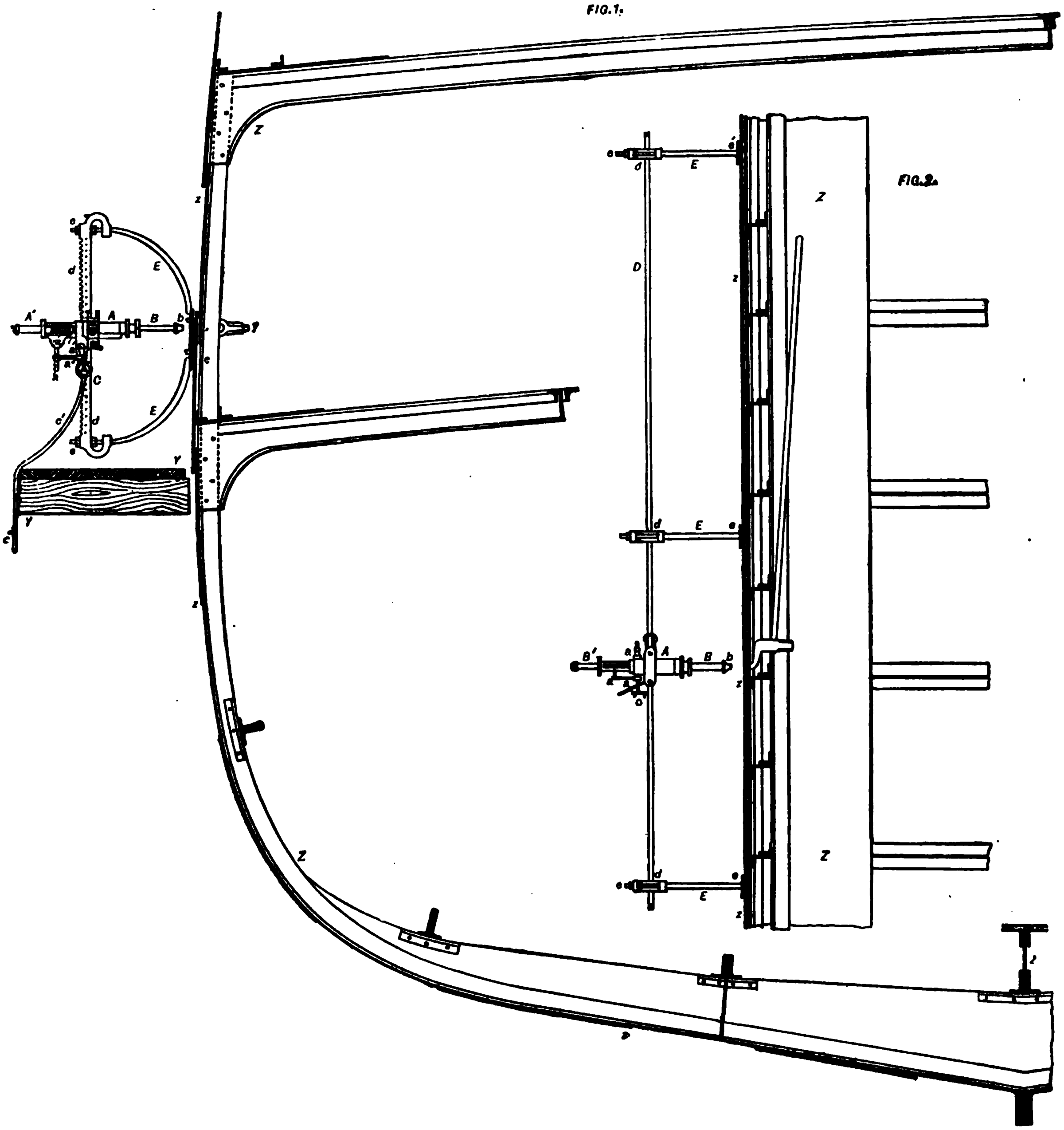
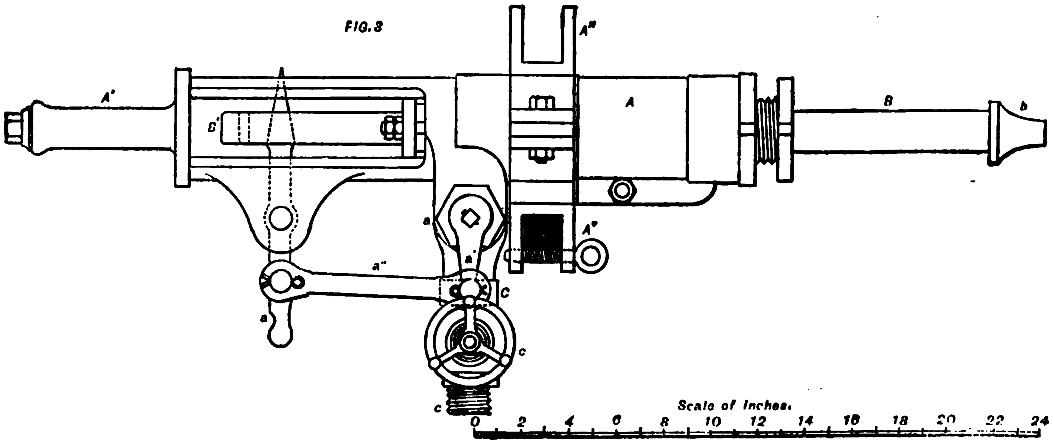


FIG. 1.

FIG. 2.

NEW PORTABLE STEAM RIVETTING MACHINE FOR SHIPS.

At the recent meeting of the Institution of Naval Architects more than one speaker referred to the importance of a good motive power rivetting machine. Indeed the feeling has long been universal that a thoroughly effective appliance of this description, would be a real boon to iron shipbuilders, enable them to



compete with their foreign rivals, who have not the same drawbacks to contend with in the shape of hours of labour very much reduced while, skilled labour is at a premium. The machine for this purpose, intended and patented by the principal partner of the well known firm of M'Millan and Son, Dunbarton, was approvingly mentioned by Mr. Humphreys, in the able paper read by him at the meeting above referred to and represented in the present number of the *Marine Engineer.* It is the machine here illustrated, and the inventor claims for it that it will rivet the plating and frames of ships as thoroughly as the stationary machines in use for rivetting steam boilers do; and adds that though many Inventions have been tried and patented for this purpose, both by steam and water-power, this machine appears to be the first practically-successful one for doing its work in a better and cheaper manner than can be done by hand labor, as each machine, with the same complement of Heaters, Holders-on and Dressers, and only one skilled man to guide it, can perform at least a half more, and better work, than can be done by the usual rivetters and their attendants—thus effecting a saving of from 25 to 30 per cent, on this part of the work of shipbuilding,

The cylinder stuffing glands and stop valve are made of the best gun metal, the piston and piston rod are solid. and made of steel, and the valve levers, screw links, and supporting shackles, are made of the best wrought-iron. The brackets and horizontal bar for attaching the machine to ship's side are also made of wrought-iron. The steam is conveyed to the machine by an indiarubber pipe from a small portable boiler, placed on either side of ship; and with a pressure of steam of from 40 to 45 lbs. only, a vertical boiler of 8in. × 4in. is amply sufficient to work six to eight machines.

Fig. 1 shows a half-transverse section of an iron-plated ship Z, with the rivetting machine, A B, and its carrying frame, shown as mounted ready for, and in the act of rivetting a part of the upper streaks of plates, z; and Fig. 2 is a plan view of the same corresponding thereto, both to a small scale; while Fig. 3 is an elevation to a large scale of the Portable Steam Rivetting Cylinder or Machine proper, A B, as detached.

The rivetting machine consists of a steam cylinder, A, with steadying back handle, A', and solid piston and piston-rods, B, B', passing out through stuffing-boxed in the front and back end, with the rivetting hammer, b, secured in the front end of the piston-rod, B; while the back piston-rod, B', actuates the lever and link, a', a", of the inlet and reversing steam or cock, a, fitted in the steam inlet branch, C, with stop-valve, c, below; and having an india-rubber or hose steam-pipe, c', connected thereto, led up from a portable steam-boiler, traversed on rails along the side of the ship, Z, below or adjacent to the working platform, Y, where the steam rivetting cylinder, A, is carried by a shackle A", near its centre gravity (all seen in Fig, 3), on a single square longitudinal bar, D, so as to rivet the longitudinal rows of rivets and joints along the streaks of plate, z. The bar D is secured to, and moved up and down on end bars, d, with holes in them, for rivetting the vertical rows of holes at the end joints of the plates. These end bars, d, are carried and secured by screw nuts to the outer projecting ends, e, of carrying bow frames, E, secured near their centre by a flat flange part, and two or more bolts passed through the punched rivet holes in the plates or sides of the ship being rivetted at e', as seen particularly in Figs. 1 and 2; the rivets being inserted and held on from behind by the usual abutting or bolster hammer y; and the rivetting hammer, b, and cylinder, while rivetting, being steadied by the attendant through the handle A', at the back of the cylinder A.

RAISING A SUNKEN MAN-OF-WAR.—An interesting operation is in course of completion by the authorities of the Port of Toulon in the attempt to raise the French war ship l'Arrogante, which foundered off Hyères on the 19th of March. The total weight of the vessel is 5,000,000lb. (over 2,000 tons). Divers having been sent down to close up and calk all ports, hawse-holes, and other openings, two circular holes were cut in the deck of the vessel, into which two long tubes were inserted, the ends of which projected above the level of high water. Several pontoons with steam pumps were lashed alongside the wreck, and the water was pumped out through one of these tubes while the air was allowed to enter by the other. The first attempt to float the wreck resulted in a failure, in consequence of the deck showing signs of giving way under the pressure of the superincumbent water as the water in the hold was gradually removed. The deck of the ship lies about 13 feet below the level of the sea at low water. Divers and workmen are now engaged in supporting the decks by placing props beneath its weakest parts right down to the keel of the vessel, and when this work is completed advantage will be taken of the first conjunction of low spring tides and fine weather to commence pumping again.

ON THE USE OF STEEL IN NAVAL CONSTRUCTION.

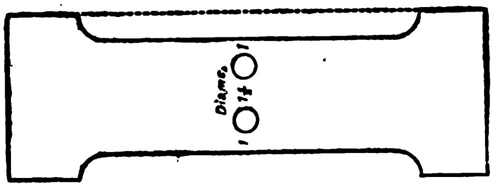
A Paper read at the meeting of the Iron and Steel Institute by NATHANIEL BARNABY, C.B., *Director of Naval Construction.*

THE council of this Institution acts wisely, no doubt, in calling up before you at your meetings the users of the material which you make with so much care and success. As one of the witnesses summoned, I fully admit that I am bound by every consideration to give evidence. Yet, the more I think about the subject-matter of the evidence, the more sensible I become of my inability to throw any strong light upon the difficulties we still find as we extend the use of steel in naval construction. When I called attention four years ago to the difficulties we had then to contend with in steel ship plates, I was performing a very ungracious task, and I appear to have given pain where I would willingly have offered only respect and admiration. I have since learned from your kindness that you have found my voice to have been that of a friend. You have learned also in the shape of orders for ship plates and angles, with which you were not previously very familiar, that naval architects, shipbuilders, and marine engineers have fully recognised the magnitude of your recent successes in producing and cheapening good ship plates of steel. I need not tell you of the recent action of the Admiralty, of Lloyds' Register, of the Board of Trade, and of all our most enterprising private shipbuilders in relation to the use of steel, but I would remind you that it is a veritable beginning of a great and inevitable change. I am aware that steel ships were built in the United Kingdom twenty years ago, but I learn also from the register kept by Lloyds' surveyors, that after the year 1866 only three small vessels were built in the United Kingdom during ten years. The real start was made in the private trade in 1878, when eleven vessels were built of steel. At this moment there are steel ships building all over the kingdom. How large a field lies open may be seen from the fact that of vessels classed by the Committee of Lloyd's Register in, or during, 1878 there was a gross tonnage of 574,819, of which 52, 657 was wood, 517,692 of iron, and 4470 of steel, *i.e.*, wood still retained 9 per cent. of the whole, and steel had only put in a claim for ¾ per cent. The new material is destined, no doubt, to occupy nearly the whole field in the future. But there was great activity in shipbuilding during the past ten years, and iron ships take a long time to wear out. Seeing how long the processes by which satisfactory steel can be produced at cheap rates have been before us, some one has been at fault in allowing us to build during our busy time in iron instead of steel. Ironmakers may fail to find any occasion for fault-finding in this respect, but they should remember that a great manufacturing people should be reluctant to lose the lead in improvement in materials and modes of manufacture, and we have certainly been very near losing it in the right application of great English inventions to the wants of shipbuilding and marine engineering.

I propose to do you the best service I can by once more finding fault, I cannot give the reasons of the defects I propose to bring to your notice, still less can I propose remedies. I am confident that it is only necessary for you to be convinced of a fault in order to overcome it. The defects of which I have to complain have come out in angle bars and not in plates. They are not due to causes discoverable by our tests. I annex the code of tests, and I do not at present see how it can be extended so as to detect the hidden cause of our troubles. The materials have been supplied by first-class firms, and made in the Bessemer converter. Recent cases have occurred of fracture in angle bars, satisfying all the test conditions, without apparent cause, or from some trifling blow or strain. One 8in. by 3in. by ⅜in. bar broke through a rivet hole after it had been bent to form and annealed, without any known cause. Another fractured in the 3in. flange to the root after leaving the slab and before it was annealed. Two others fractured in the 3in. flange while being faired on the slab after annealing. One 4in. by 3in. by ⅜in. bar fractured in the 3in. flange when one end having been annealed and the other end was about to be put in the furnace for annealing. There were other similar cases which I need not record. I should add that they nearly all took place during the late severe weather at Chatham. No doubt these bars had been treated much as iron bars would have been, the only difference being that whenever they had been bent hot they were annealed before they went to the ship. The instructions given are;—(1) All plates or bars which can be bent cold are to be so treated; and if the whole length cannot be bent cold, heating is to be had recourse to over as little length as possible. (2) All plates or bars which have been heated for bending or flanging are to be annealed afterwards over the parts which have been heated. If it is inconvenient to perform the operation of annealing at one time for the whole of a plate or bar, portions of the length may be annealed separately. (3) If desired, exceptionally long or quickly curved bars, such as frames, may be formed of shorter pieces with the butts suitably shifted and strapped. (4) No bar or plate which shows signs of failure or fracture in working should be put into a ship; but pieces should be cut from such plates and bars, and subjected to quenching and tensile tests. The details of the failures, with particulars of the subsequent tests, should be forwarded to the Admiralty. The alleged errors in treatment are, however, indicated by the following recommendations of the manufacturers after the cases of failure had been carefully considered by them:—

> "In all cases where the bending of the bars cannot be completed whilst at a dull red heat, we should suggest that it be done at one or more heats according to the amount of bending required, so that the work may all be finished before the bar becomes black and cold. That all joggles should be made when the bars are hot and that they should be annealed afterwards. That so far as is practicable all bars that have been worked hot should be passed through the annealing furnace before they are allowed to go cold, and this could be easily done with a furnace properly arranged for the purpose.
>
> "That after the bars have been annealed they should not be heavily hammered but if this is necessary, they should be annealed again. That any setting of bars after annealing should, as far as possible, be done by hydraulic or other apparatus, so as to do away with the necessity of punishing the material with heavy hammers more than is absolutely necessary, and that this work be done by the smiths who bend the bars."

I have no reason to complain of the view taken by the manufacturers, because we have always been warned by them that this additional care was necessary. I can only say that so long as it is necessary it is an obstacle of a serious kind to the use of steel angles for the frames of ships. These precautions are of the same nature as those I said in my paper of 1874 were in use in France. Substituting the word bar for plate, the words I used—a quotation from an official memorandum of the engineers at L'Orient—were:—If it is impossible to work the bars without hammering, or without local pressures of great severity, or if the curvature given is considerable, it is necessary to proceed with care and skill to avoid ruptures in the course of the operation. The hammering ought to be done with light blows delivered over as large a surface as possible, and the curvature ought to be produced not at once but by successive stages. After the work has been done the bar should be promptly annealed. One ought to avoid as much as possible partial or rather local heating. When by careful treatment the bar has been brought to its proper form, the annealing process should be immediately resorted to, and the heat should be applied very gradually, for a sudden augmentation of temperature in a point where the molecular tensions are already exaggerated might cause a rupture. When the bar has been regularly heated to a sufficient temperature, and is left to cool slowly, the bad effects of the local cisturbances will be destroyed and homogeneity will be re-established. Steel makers on that occasion could not believe that such precautions were necessary, but they are repeated now on the best authority in England, in 1879. Do not let it be supposed that I allege any inferiority in the angle bars supplied either to those in use in France or to the standards of our own tests. I only say that so long as these characteristics of steel bars remain, we shall probably prefer iron. A peculiatity in these angle bars distinguishes them from iron, *i.e.*, when the end of a bar is cut off roughly and is left ragged, the leaves break off suddenly if struck heavily whereas the other end of the same bar trimmed off evenly will bear heavy sledging without rupture. The one end behaves far better than common iron would; the other far worse. Is this disagreeable peculiarity unavoidable? I have already stated that we have great reason for satisfaction in plates. Stating the results broadly, we find that:—(1) Iron suffers more in punching when the holes are near the edge than when they are farther removed; but in mild steel the material suffers less from the effect of punching when there is one diameter of the rivet clear of the edge, than when the hole is so distant as to avoid bulging the edge. In the former case *i.e.*, when there is about one diameter of hole clear of the edge the loss of strength caused by punching Landore-Siemens steel plates from ¼in. to ½in. thick, is about 12½ per cent. of the strength of the unpunched test-piece. In thicker plates, 9/16in. to ¾in., similarly treated, both Siemens and Bessemer plates lost between 6 and 16 per cent. When the distance of the hole from the edge was increased in plates above ½in. thick, thus



Holes punched before shaping.

the loss "on open earth" plates was from 9 to 19 per cent., and on plates made in the converter from 11 to 30 per cent. Best best iron treated similarly lost, when the holes were one diameter from the edge, from 15 to 20 per cent., averaging about 17 per cent. of the full strength of the unpunched test-piece. When the shaping of the iron samples was done after the punching, the loss fell to an average of 11 per cent., varying between 5 and 15 per cent. The average results for plates above ½in. in thickess, punched and unannealed after punching stand as follows :—The pitch of the holes was in all cases I record in this paper a minimum for ship work, as shown above,

	Breaking strengths per square inch.				
	Plain unpunched. Average.	Punched before shaping. Average.	Punched after shaping. Average.	Maximum strength of samples after punching.	Minimum strength of samples after punching.
Open hearth steel ...	27·6	23·7	24·5	26·0	21·0
Converter do. ...	27·5	21·7	24·8	26·0	21·0
Best-best iron	21·5	19·0	17·7	21·0	15·0

It will be seen that there is not a marked difference here between the open hearth and converter makes of steel. In respect of the injury done by punching, as in the endurance of all the prescribed tests, including severe percussive tests, the metals made by two processes do not differ much, and if the drill is used, or if the plates are annealed after punching, it would be impossible, I think, to establish a marked superiority of one make over the other. But there is a remarkable difference in the behaviour of the two descriptions of steel when rivetting has been done upon plates which have been punched and not subsequently annealed. The following are examples of plates above half an inch thick, butt jointed and treble rivetted:—

		Breaking strength in tons per sq. inch.	
		Annealed before rivetting.	Unannealed before rivetting.
Countersunk points, not countersunk through...	Open hearth steel	30·6	29.84
	Converter ,,	30·2	21.8
	Best-best iron	—	19·9
Snap points	Open hearth steel	28·6	21·2
	Converter ,,	26·9	15·25
	Best-best iron	—	18·2

The countersinking in these cases is carried nearly but not quite through the plate, so that a small part of the material damaged by the punch is left in the hole. In the steel made by the open hearth process the loss of strength as compared with the annealed plates is inappreciable. The result 25·84 tons, is a mean of six tests. But in the steel made in the "converter" the loss is serious, the mean of four very carefully made tests being 21·8 tons; the mean of eight tests, some of them not being entirely satisfactory, gives a lower result still. In the open hearth steel with the holes countersunk in this manner, the superiority in the normal strength of the material, as compared with iron, is more than maintained in the rivetted butt joint.

When the countersinking is carried completely through, the converter made steel recovers the lost ground, as will be shown further on.

	Strength in tons per sq. inch.	
	Plain strips.	Treble rivetted butt joint.
Steel	27·6	29·8
Best-best iron	21·5	19.9
Ratio of steel to iron	1·28·1	1·49·1

The superiority of the rivetted strips is apparently due to the friction of the surfaces. The friction was also operating in the case of the iron, and reducing the loss by punching. In order to place them on an equality, and avoid all injury by punching we have issued the following instructions as to the use of mild steel made by either process. In outer bottom plating, the holes which are to be countersunk should be punched about ⅛in. less in diameter than the rivets which are used, the enlargement of the holes being made in the countersinking, which should in all cases be carried through the whole thickness of the plates. It is not necessary to anneal plates or bars after punching as a means of making good damage done in punching. All butt-straps to plating which forms an important feature in the general structural strength, such as the outer bottom plating, deck plating, deck stringers, &c., should have the holes drilled or be annealed after the holes are punched. Snap rivetting is only to be employed for the internal work on transverse bulkheads, floors, framing, and other subordinate parts of the structure; but on stringers, deck plating, and other parts subjected to considerable tensile strain, countersunk rivetting is to be used, and the hole treated similarly to those in the outside plating. Acting on these principles, we are quite satisfied that steel bottom plating for ships needs neither drilling nor annealing after punching. I attach copies of the last set of tests made at Chatham. Abstracting from them, I find that, on comparing plates treated and rivetted up in the same manner, the steel made by the open hearth process still manifests a certain appreciable superiority to that made by the converter. There is in the latter process more variation of strength to resist rupture across the line of rivet holes. The average breaking strain per square inch of the material through the line of fracture at the rivet holes, reckoning the area of the section before it began to stretch, is as given below. With it I have compared the lowest and highest of the breaking strains of the same make of material in the set of tests.

	Tons per square inch.		
	"Open hearth."		"Converter."
	No. 1.	No. 2.	—
Average	31·027	28·0	30·27
Percentage of the maximum above average	7·284	10·64	11.56
Percentage of the minimum below average	5·11	8·43	25·0

It is possible that boiler-makers may not at first sight appreciate the advantage of avoiding the drill, but a little reflection will satisfy them I think, that so long as steel needed either the drill or the annealing furnace before it could be worked into the bottom of a ship, it was not likely to displace iron in shipyards. It is to the power of the mild steel and particularly the open hearth steel we are now getting, to bear punching without severe loss that its recent successes are mainly due. We may now confidently say that well made steel punched and countersunk through and unannealed has 50 per cent. more strength through a line of rivet holes than iron has.

In the matter of oxidation in salt water, we have found by a series of trials, extending over and about three and a-half years, that the rates of oxidation of three plates of iron of the same brand differed more among themselves than they differed from steel. That when the surfaces of steel plates are carefully freed from the black oxide produced in the rolls by a wash of weak acid or otherwise,

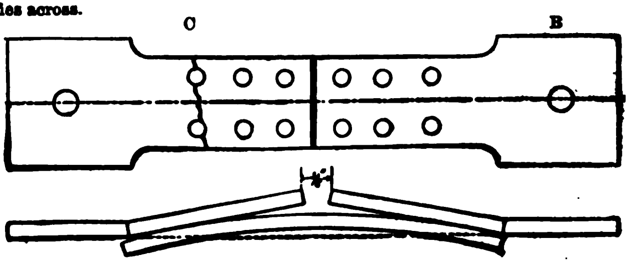
Details and Results of Experiments made at Chatham Dockyard during the Winter 1878-79, to ascertain the Effects of Rivetting on various Kinds of Mild Steel, Punched and Countersunk through, but not Annealed.

Distinguishing between that made by the open hearth and that by the converter.	Distinguishing Nos. of tests.	Thickness of plate.		Width of plate.			Sectional area of plate through rivets.		Rivets.		Breaking strain in tons,						Temperature of test-house in deg. Fah.
					Through rivets.								Per square inch of				
		Normal.	After breaking.	Whole.	Normal.	After breaking.	Normal.	Reduced.	Diameter.	Nature.	Actual producing rupture.	Mean.	Normal area.	Reduced area.	Means. Normal.	Means. Reduced	
O.Hl·	1	·695	·595	5·123	2·623	2·450	1·824	1·457	$\frac{15}{16}$ in. ·9375	Ordinary Staffordshire iron. Pan heads, countersunk points, conical heads.	53·875	54·125	29·54	37·15	29·7	37·29	55
	1A*	·70	·60	5·100	2·600	2 420	1·820	1·452			54·375		29·87	37.44			54
C·	1	·73	·71	5·200	2·700	2·680	1·971	1·902			44·750	52·875	22·70	23·52	26·61	30·65	54
	1A	·74	·63	5·200	2.700	2·562	1·998	1·614			61·000		30·53	37·79			54
O.H$_2$.	1	·74	·565	5·187	2·687	2·500	1·989	1·412			55·875	56·875	28·09	39·57	28·59	41·23	53
	1A	·74	·56	5·187	2·687	2·410	1·989	1·349			57·875		29·09	42·9			53
O.H$_1$.	2	·645	·54	5·125	2.750	2·545	1·774	1·374			58·625	58·500	33·04	42·66	32·75	41·57	54
	2A	·66	·56	5·100	2·725	2·575	1·798	1·442			58·375		32·46	40·48			55
C.	2	·70	·60	5·250	2·875	2·685	2·012	1·611			56·750	56·687	28·20	35·22	28·17	33·77	55
	2A	·70	·65	5·250	2·875	2·695	2·012	1·751			56·625		28·15	32·33			55
O.H$_2$.	2	·66	·53	5·187	2·812	2.625	1·856	1:391			50·875	50·312	27·41	36·57	27·10	35 02	55
	2A	·655	·56	5·187	2·812	2·655	1·842	1·486			49·750		26·80	33·48			55
O.H$_1$.	3	·61	·538	4·625	2·437	2·29	1·486	1·232	$\frac{13}{16}$ in. ·812		43·875	44·375	29·52	35·61	29·86	37·30	56
	3A	·61	·565	4·625	2·437	2·282	1·486	1·151			44·875		30·20	39 00			56
C.	3	·61	·581	4·593	2·405	2·262	1·467	1·312			41·750	43·250	28·46	31·82	29·77	34 82	56
	3A	·61	·53	4·625	2·437	2·232	1·487	1·183			44·750		30·09	37·82			56
O.H$_2$.	3	·61	·48	4·562	2·374	2·142	1·448	1·028			40·375	39·562	27·88	39·27	27 32	37 72	55
	3A	·61	·49	4·562	2·374	2·187	1·448	1·071			38·750		26·76	36·18			55
O.H$_1$.	4	·55	·47	4.56	2·435	2·295	1·339	1.098			40·875	40·187	30·52	37·91	30·00	38·00	55
	4A	·55	·45	4·562	2·437	2·305	1·340	1·037			39·500		29·48	38 09			56
C.	4	·55	·315	4·625	2·500	2·335	1·375	1·202			42·000	42·250	30·54	34·94	31·01	36·11	56
	4A	·54	·48	4·625	2·500	2·375	1·350	1·140			42·500		31·48	37·28			58
O.H$_2$.	4	·56	·42	4·562	2·437	2·305	1·365	·968			35·003	35·187	25·64	36 15	26·19	36·57	58
	4A	·55	,43	4·530	2·405	2 225	1·323	·956			35·375		26·74	37·00			56
O.H$_1$.	5	·47	·41	4 250	2·312	2·132	1·048	·874	$\frac{3}{4}$ in. ·75	Ordinary Staffordshire iron. Pan heads, countersunk points, conical necks.	32·010	32·875	29·44	37·75	30·24	39·18	56
	5A	·47	·39	4·250	2·312	2·132	1·087	·831			33·750		31·05	40 61			55
C.	5	·475	·40	4 187	2·250	2·112	1·069	·845			32·875	33·812	30·75	38·90	31·46	41·30	55
	5A	·48	·38	4·187	2·250	2·092	1·080	·795			34·750		32·18	43·71			58
O.H$_2$.	5	·48	·406	4·187	2·250	2 062	1·080	·837			30·000	30·250	27·77	35 84	28·00	37 39	58
	5A	·48	·38	4·187	2·250	2·062	1·080	·783			30·500		28·24	38 95			55
O.H$_1$.	6	·36	·30	4·230	2·417	2·218	.870	·665			27·875	26·875	32·04	41 91	31 31	38·62	55
	6A	·35	·32	4·230	2·417	2·287	·846	·732			25·875		30·58	35 34			55
C.	6	·38	·31	4·187	2·375	2·247	·902	·696			27·875	28·312	30·90	40·05	31·38	43·09	55
	6A	·38	·285	4·187	2 375	2·187	·902	·623			28·750		31·87	46 14			55
O.H$_2$.	6	:38	·29	4·187	2·375	2·227	·902	·645			25·000	25·250	27·71	38·76	27·99	38 87	55
	6A	·38	·295	4·187	2 375	2·217	·902	·654			25·500		28·28	38·99			55
O.H$_1$.	7	·24	·20	3·500	2 000	1·900	·480	·380	$\frac{5}{8}$ in. ·625		16·000	16·100	33,33	42 10	33·33	45·81	56
	7A	·24	·17	3·500	2·000	1·900	·480	·323			16·000		33·33	49 53			55
C.	7	·24	·195	3·520	2·020	1·875	·485	·365			16·375	16·250	33·76	44·86	33·50	47 39	55
	7A	·24	·17	3·520	2·020	1·900	·485	·323			16·125		33·24	49 92			55
O.H$_2$.	7	·24	·201	3·500	2·000	1·875	·480	·376			14·750	14·812	30·73	39·23	30·85	40·80	55
	7A	·24	·19	3·500	2·000	1·850	·480	·351			14·875		30·98	42·37			55

* A signifies across.

Comparison of Tons per Square Inch for the various makes of Steel.

	Maximum strain obtained.	Minimum strain obtained.	Average of all the tests.
O.H$_1$.	33·33	29·44	31·027
C.	33·76	22·70	30·27
O.H$_2$.	30·98	25·64	28·00



the surface corrosion in salt water is very uniform. That when the surface oxide is left on, the effect of the oxide upon the neighbouring bared metal is as strong and continuous as copper would be. In conclusion, I would invite your most serious attention to the necessity for giving us uniformly sound steel in large masses to replace our iron forgings at a price not much above that of forgings. England is in danger of losing the lead in this matter. We are at this moment undoubtedly behind France in some respects in the production of such steel by modern processes. Crucible steel is out of the question for the bulk of the work in naval construction. We must look to the converter and to the regenerative furnace.

for this material. If you can produce it without forging, as I hope you may, we may then build our entire ship and engines of steel.

Tests for Plate, Beam Angle Bulb and Bar Steel, used in Building Ships for her Majesty's Navy.—Strips cut lengthwise or crosswise to have an ultimate tensile strength of not less than 26, and not exceeding 30 tons per square inch of section, with an elongation of 20 per cent. in a length of 8in. The beam, angle, bulb, and bar steel to stand such forge tests, both hot and cold, as may be sufficient in the opinion of the receiving officer to prove soundness of material and fitness for the service. Strips cut crosswise or lengthwise 1½in. wide, heated uniformly to a low cherry red and cooled in water of 82deg. Fah., must stand bending in a press to a curve of which the inner radius is one and a-half times the thickness of the steel tested. The strips are all to be cut in a planing machine, and to have the sharp edges taken off. The ductility of every plate, beam, angle, &c., is to be ascertained by the application of one or both of these tests to the shearings or by bending them cold by the hammer. All steel to be free from lamination and injurious surface defects.

LAUNCHES AND TRIAL TRIPS.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of The Marine Engineer as complete and reliable as possible, and will thankfully receive all such information or accounts of any novelties relating to any branch of the marine engineering trades. *To ensure insertion, all such favours should be in our hands by the 26th, of the month.* —Ed.]

LAUNCHES.

ENGLISH.

Abeona.—On the 6th May there was launched from the shipyard of Messrs. Raylton Dixon and Co., Middlesborough, the second of the two sister ships which this firm have been building to the order of Messrs. E. Harris and Co., of Middlesborough, the first of which we announced a month ago. They are 178 feet long, 25 feet 6 inches beam, and 14 feet depth of hold, with water ballast both fore and aft, and will have engines of 70-horse power. The ship was christened the Abeona, by Mrs. Whipham, of Southfield Lodge.

Edgar.—On May 6th, Messrs. S. Turnbull and Son launched from the Whitehall Dockyard, Whitby, a new screw steamship of the following dimensions:—Length, 243 feet 6 inches; breadth, 33 feet; depth, 22 feet, with a deadweight capacity of 2,100 tons, and engines of 130-horse power, by Blair and Co., Stockton-on-Tees. She will be classed 100 A 1 at Lloyd's, under the three-decked rule, and special survey of hull and engines, and has been built for the firm of builders, Messrs. Turnbull and Son, for the Black Sea Trade. On leaving the ways she was named the Edgar.

Amoor.—On the 6th inst., there was launched from the shipbuilding-yard of Messrs. C. S. Swan and Co., at Wallsend, an iron screw steamer, of the following dimensions:—Length between perpendiculars, 285 feet; breadth (extreme), 35 feet 3 inches; depth moulded, 27 feet 7 inches; and about 2,900 tons burden. The steamer has been built under special survey to class 100 A1 at Lloyd's, and is intended for the Atlantic and Indian trades. She will be fitted with a pair of compound surface condensing engines of 200-horse power, by Messrs. Black, Hawthorn and Co., of Gateshead, combining all the latest improvements for efficiency and economy of working. This vessel has been built to the order of the Mercantile Steamship Company (Limited), London, and was named the Amoor as she left the ways.

Bedowin.—On May 6th, there was launched from the shipbuilding-yard of Messrs. C. Mitchell and Co., Low Walker, an iron screw-steamer of the following dimensions:—Length 293 feet 9 inches, breadth 35 feet, depth 25 feet, with a carrying capacity of about 3,000 tons deadweight. The steamer will be fitted with powerful engines by the Wallsend Shipway Company (Limited). The vessel has been built to the order of Messrs. W. and R. Thomson, of Liverpool, and as she left the ways was named the Bedowin by Miss Frazer.

Eivian.—On the 3rd May, Messrs. Osborne, Graham and Co., launched from their yard, at Hylton, an iron sailing barque of about 1,120 tons nett register, for the North Wales Shipping Company. The vessel will take the highest class at Lloyd's, and also in the Liverpool Underwriters' Registry, and be fitted up for the Indian trade. As she left the ways she was named the Eivian by Miss J. Moore.

Hesper (Barge).—On the 12th May a new barge, of about 120 tons register, named the Hesper, built by Mr. J. H. Vaux, Harwich, was launched from the shipway of the Royal Naval Yard.

Omonia.—On the 9th inst., a steamtug named the Omonia was launched from the building-yard of Messrs. Wouldhave & Johnson, Low Lights, North Shields. She has been built to the order of Messrs. Hepple and Co., South Shields. Her dimensions are:—Length, 105 feet; breadth, 19 feet 6 inches; depth 10 feet. She is intended for towage service at Constantinople and the Black Sea. Her engines are to be supplied by the Owners, and will be of 100-horse power. She is classed for 7 years at Lloyd's. A very powerful fire-engine will be fitted in her capable of throwing about 2,500 gallons of water per minute. The boat was named by Mrs. Charles Gibson, of North Shields.

Peninsular.—On 5th of May the launch took place at the shipbuilding-yard of Messrs. J. L. Thompson and Sons, of Monkwearmouth, of the screw steamer Peninsular, which has been built expressly for the Spanish pyrites trade, for which she has been already chartered to the end of 1881 by the Owners, Mr. Henry Schofield and Messrs. Charles Tully and Co., of Newcastle. The dimensions are as follows:—Length 265 feet, breadth 35 feet, depth of hold 19½ feet, deadweight capacity 2,200 tons on 18 feet mean depth. The classification is 100A at Lloyd's, which is the highest class. After the launch the vessel was towed round to the Tyne, where she is to receive her engines from Messrs. R. and W. Hawthorn. They are of 160 nominal horse-power, cylinders, 62 and 32 inches diameter, with 40-inch stroke; boilers working up to 80lbs. pressure, and furnished with all the latest economical improvements.

Rumney.—On the 24th of April a new screw steamer, named the Rumney was launched from the shipbuilding-yard of Messrs. W. Doxford and Sons, Sunderland. The Rumney is built to the order of Messrs. John Cory and Sons, of Cardiff, for the ore and Baltic trade, and is classed 100 A 1 at Lloyd's. She is schooner-rigged, with iron decks fore and aft, and is supplied with all the latest improvements in ventilation, &c. She will be commanded by Captain Williams. Her dimensions are—between perpendiculars, 200 feet; breadth of beam, 29 feet; depth of hold, 14 feet 6 inches. Her carrying capacity is about 1,100 tons. She is supplied by the builders with compound condensing engines of 100-horse power.

Rio Apa.—On May 12th, Messrs. Henry Murray and Co., of Port Glasgow, launched a fine paddle steamer, the dimensions of which are:—Length, 220 feet; breadth, 26 feet; depth of hold, 9 feet. The steamer is named Rio Apa. She is built to the order of Mr. David Rowan, Engineer, Glasgow, and is intended for river traffic at the Brazils. The engines are by Mr. Rowan, and are described as of great power, and constructed on the "steeple" principle. The fittings of the steamer include accommodation for passengers. A cabin on the main and spar decks will accommodate 50 first-class passengers, and cabins to be fitted on the main deck abaft the forecastle will accommodate 60 second-class passengers. On the saloon there is a mid-ship deckhouse, with galley on the fore end, the house having accommodation for engineers, Engineers' Mates, the First Mate, &c., The forecastle is fitted up for 24 of a crew.

Scindia.—On April 24, Messrs. William Denny and Brothers, Dumbarton, launched from their building yard, an iron screw steamship of the following builders' dimensions:—310 feet by 39 feet by 27½ feet, and above 2,640 tons gross register. This vessel has been built to the order of the British India Steam Navigation Company (Limited), and is in all respects similar to the Sirdhana, launched by the same firm a month ago. Her engines, which will be on the direct-acting compound surface condensing principle, of 270-h.p. nominal, and having cylinders 38 inch and 68 inch diameters, stroke 4 feet, will be supplied by Messrs. Denny and Co., Engineers. The ceremony of naming the vessel the Scindia was performed by Miss Tulloch, daughter of the late John Tulloch, Esq., of Bellfield.

Velocity.—At the beginning of last year the Great Grimsby Ice Company had three iron screw cutters built at Middlesboro' to act as tenders for the large fleet of fishing smacks—numbering over 700, and varying in size up to 80 tons—which fail from the port of Grimsby to the Doggerbank and other deep sea fishing grounds. These steam tenders, which are 130 feet long, 21feet beam, and 10½ feet depth of hold, are 190 tons gross register, and have engines of 50-horse power, are especially constructed for great speed. Their vocation is to carry ice and packing cases out to the fleet of fishing boats and bring back the take of fish for the Grimsby market, or, in some cases, to run with their freights direct to Billingsgate, thus enabling the fishing fleet to remain at sea for weeks together, and yet deliver their take fresh and regular to the market. Such has been the success obtained by the Precursor, Dispatch, and Celerity, the three steam cutters above alluded to, that the company recently commisioned Messrs. Raylton Dixon and Co. to build them another on the same lines, which was launched on the 10th May, and will be ready for sea in two or three weeks' time. On leaving the ways she was christened the Velocity by Miss Mabel Dixon, daughter of the builder.

Waterloo.—On the 6th May, the London and Glasgow Shipbuilding Company (Limited), launched from their shipbuilding-yard, at Govan, an iron screw steamer of 130-horse power, built to the order of Messrs. Allan C. Gow and Co. Her dimensions are:—Length, 254 feet; beam, 33 feet; depth of hold, 18 feet 6 inches. She has a raised quarterdeck 3½ feet high, with long bridge for Engineers, and in front, large capacity for cargo, also a topgallant forecastle for Crew. She is fitted with powerful steam winches and Napier's steam windlass; has a double bottom for water-ballast in fore and after holds, and all the latest improvements. She is built in excess of Lloyd's highest class, and specially arranged for the Mediterranean, Black Sea, Baltic, and Atlantic trades. As the vessel left the ways she was named the Waterloo by Miss Gow, of Kilcreggan, daughter of the late Allan C. Gow.

Ranee.—On May 13th, there was launched from the shipbuilding yard of Messrs. David and William Henderson and Co., at Patrick, an iron steam yacht of the following dimensions:—Length, 140 feet; breadth, 20 feet 3 inches; depth, 11 feet; tonnage (builder's measurement), 250 tons. On leaving the ways she was named Ranee.

Stella.—Messrs. John Softley and Son, iron shipbuilders, South Shields, have this week launched two iron paddle steam tugs from their yard. The first is of the following dimensions:—Length, 85 feet; breadth, 17½ feet; and depth, 8 feet 3 inches. The steamer has not been named, and will be employed in towing at Taganrog. The second was named the Stella. Her dimensions are:—Length, 80 feet; breadth, 17½ feet; depth, 8 feet 3 inches. She will be fitted with engines of 40-horse power, by Messrs. Baird and Barnsley, North Shields, and will be engaged to carry passengers from Bournemouth to other places in the English Channel.

Roumania.—On the 22nd May, Messrs. W. Gray and Co., of West Hartlepool, launched a new iron screw steamer. Her dimensions are:—Length between perpendiculars, 343 feet 9 inches; breadth, 32 feet; and depth of holds, 18 feet 6 inches and 22 feet 6 inches; her gross tonnage is 1,320 tons, will carry a deadweight of 1,850 tons; classed 100 A 1, the highest class at Lloyd's; engines, 120-horse power, by Messrs. L. Richardson and Sons, of the Middleton Ironworks, Hartlepool; has complete double bottom for water ballast, raised quarter deck, long bridge, topgallantforecastle for crew, three steam winches, steam windlass, and all the latest improvements for the rapid loading and discharging of cargo. The new steamer was christened the Roumania by Miss Blanche Gray, of Greatham, near West Hartlepool.

IRISH.

Maharani.—On the 26th April, there was launched from the iron shipbuilding works of Messrs. Harland and Wolff, Queen's Island, Belfast, a screw steamer named the Maharani. She is the fourth of a fleet of vessels that has been constructed by the same firm for the Asiatic Steam Navigation Company of Liverpool, and her dimensions are:—306 feet in length, 31 feet 6 inches breadth of beam, and about 1,665 tons gross register. Like all the other vessels of the fleet the Maharani will be rigged and fitted out in Belfast.

SCOTCH.

Macleod.—On the 22nd May, Messrs. A. M'Millian and Son, Shipbuilders, Dumbarton, launched a new iron sailing ship, of 1,620 tons gross register, which was named Macleod. This ship is the property of her builders, and has been named in compliment to Mr. Macleod, of the Dumbarton Sawmills. She has for her figurehead a likeness of that gentleman, and was named by his daughter, Miss Macleod. The Macleod was at once placed under the Builders' large steam crane at the works to get her masts and yards put into position, and will be ready early in June to take on board her cargo for the East.

Alexandra.—On 28th April, Messrs. Scott and Co., launched from their shipyard, Cartsdyke, a paddle steamer for the Portsmouth, Ryde, and Isle of Wight Steampacket Company. The following are her dimensions:—Length, 170 feet; beam, 20 feet; hold, 9 feet; gross measurement, 336 tons. Her engines are 172-horse power. She has a nice saloon house aft, which will be fitted up with every comfort for passengers. As she left the ways she was named the Alexandra. This is the fifth paddle steamer of that name built on the Clyde. After the launch the steamer was taken in tow by the tug Lord Derby, and put under the crane at the East India Harbour to be fitted up before proceeding to Portsmouth.

Arauco.—On April 24th, a steamer was launched from the shipbuilding-yard of Messrs. Gourlay, Brothers and Co., Dundee. On leaving the ways, the vessel was named the Aruco, by Miss Balfour, daughter of Mr. Balfour, of the firm of Messrs. Balfour, Williamson and Co., Liverpool. She has been built to the order of the Pacific Steam Navigation Company, Liverpool, and will be engaged in that company's coal trade on the West Coast. The dimensions of the Arauco are:—Length, 200 feet; breadth 29 feet; and depth of hold, 15 feet 6 inches. She is 850 tons gross register, and her engines are compound surface-condensing, of 110-horse power. She is fitted with all modern improvements and her hold is self-trimming.

City of Agra.—On the 6th May Messrs. Charles Connell and Co., Scotstoun, launched the City of Agra, an iron screw steamer of 3,500 tons gross, for Messrs. George Smith and Sons', City Line of steamers, loading to Calcutta, via the Suez Canal. This vessel, which as been built considerably in excess of Lloyd's requirements for their highest class, is fitted up for a number of passengers, and is supplied with all the latest appliances. The City of Agra is also the largest, and is the sixth steamer and fourteenth vessel, built for them by Messrs. Connell and Co. As she left the ways she was named by Mrs. George Smith, and immediately proceeded to the Finnieston crane to receive her machinery, which is being supplied by Messrs. John and James Thomson, Finnieston Engine Works.

Edinburgh Castle.—On April 29th, Messrs. Robert Duncan and Co., launched a new paddle steamer for the Lochgoil and Loch Long Steamboat Company, which is intended to occupy the route upon which the steamers Carrick Castle and Windsor Castle are so well known. The new steamer was named Edinburgh Castle. Her dimensions are:—Length, 205 feet breadth 19 feet 6 inches; depth of hold, 7 feet 3 inches. She will be supplied by Messrs. Rankine and Blackmore with engines, which are on the diagonal jet-condensing principle, the cylinder being 50 inches diameter, with a piston stroke of 5 feet 6 inches.

Fire Queen.—On May 3rd there was launched from the building-yard of Mr. J. E. Scott, Cartsdyke, a screw steamer, named the Fire Queen, of the following dimensions, viz.:—Length, 180 feet; breadth, 25 feet; depth of hold, 14 feet 3 inches. Deadweight cargo capacity, 650 tons, and to class 100 A1 at Lloyd's under special survey. She is the property of Messrs. Henry Lamont and Co., 30, Gordon-street, Glasgow, and is intended as a consort to their steamers Fire King and Sardonyx, well-known in the Glasgow and Liverpool trade. Immediately after the launch she was towed to Glasgow to receive her engines and boilers.

Retriever.—On the 12th May, there was launched from the shipbuilding-yard of Messrs. Blackwood and Gordon, Port Glasgow, a screw steamer, of the following dimensions:—175 by 24 by 13. She will be fitted with compound engines of 80 n.h.p., made by the Builders. On leaving the ways she was named the Retriever, by Miss Maggie Blackwood, youngest daughter of the Builder. This steamer is constructed for submarine cable service in the Mediterranean, and is the property of the Eastern Telegraph Company. She is fitted with cable tanks, and is to have all the newest and most approved appliances. When all is completed she proceeds to London.

Amethyst.—On the 8th May, the steamer Amethyst, built to the order of Mr. P. M. Duncan, coal merchant, Dundee, was launched from the yard of Messrs. Gourlay, Brothers and Co., Dundee. The vessel, which is registered as of 925 tons gross, is 218 feet in length, 28 feet 10 inches in breadth, and her hold 15 feet 6 inches deep. She will be supplied with engines of 100-horse power.

Titania.—On May 22nd, there was launched from the shipbuilding yard of Messrs. Ramage and Ferguson, Leith, a screw steam yacht of 310 tons Y.M., built to the order of John Lysaght, Esq., Bristol. Her dimensions are 145 feet by 21 feet by 12 feet, and her engines of 65-horse power nominal, are to be supplied by Messrs. Rankin and Blackmore, Greenock. She is rigged as aschooner, and all her fittings throughout are of the improved and modern description, her construction having been superintended by Mr. Alfred H. Brown, Naval architect, London. She was named the Titania by Miss Lysaght, daughter of the Owner, and after the launch was towed to the Albert Dock, where she will be fitted out for a cruise to Norway.

TRIAL TRIPS.

Amy.—Lord Alfred Paget's new yacht Amy, of 280 tons and 40 nominal horse power, was recently tried on the measured mile in Erith the Long Reach, to test the efficiency of a four-bladed cycloidal propeller, recently fitted to this yacht by Messrs. Redpath and Paris, of Limehouse. The trial turned out in every way a success, the speed of the yacht being 11.53 knots, or an increase of 1.4 knots of her former propeller, the revolutions of the engines at the same time being brought down from 145 to 135 per minute. The vibration was found reduced to a minimum, being barely perceptible either in the cabins or on deck. The steering of the yacht was also found to be greatly improved, whilst it was discovered that the Amy could be steered as well when going astern as when going ahead.

The Arab.—The Arab (s), built for the Union Steamship Company's Royal Mail Service between the United Kingdom and the South African Colonies, was tried at the measured mile in Stokes Bay, on Tuesday, prior to her delivery to the company by the contractors, Messrs. James and George Thomson, of Glasgow. The Arab realised a mean speed of 14.261 knots, which would indicate even greater rapidity than the Pretoria, Durban, and German, owned by the Union Steamship Company, which have made such rapid passages between England and the Cape of Good Hope.

Rose Ann.—On April 26, the new steamer, Rose Ann, went down the Clyde on her trial trip. She is a screw steamer, 100 feet long by 19 feet broad, and 9 feet depth of hold, and classed 90 A1 at Lloyd's. She was built by Messrs. H. M'Intyre and Co., Paisley, for Mr. James O'Brien, Fish Merchant, Glasgow, by whom she will be employed in the herring fish trade. Her engines which are compound surface-condensing, are supplied by Messrs. Hutson and Corbett, Glasgow. After a run between the Cloch and Cumbraes, the speed attained was considered highly satisfactory. The Rose Ann is a sister ship to the steamship Mary Ann, built by Messrs. H. M'Intyre and Co., for the same Owner about two years ago.

The Senior.—On May 2, the Senior (s), made her trial trip from the yard of Messrs. Raylton Dixon and Co., Middlesborough. This vessel has been built to the order of Messrs. Renys and Sons, of Rotterdam, and is especially desired for the iron ore trade from Spain. She is 245 feet long, 30 feet beam, and 16 feet depth of hold; has iron decks fore and aft, three steam winches, and water ballast in both holds; and will carry 1,515 tons dead weight on 16 feet draught. She is fitted with engines of 130-horse power, and on her trial trip gave most satisfactory results. After the trial she proceeded direct to Rotterdam.

G. W. Ward.—On May 8th, the G. W. Ward (s), left Messrs. Schlesinger, Davis and Co.'s yard, Wallsend, for her trial trip. She preceeded as far as Newbiggen, and thence returned to the Tyne. The engines, which have been supplied by Messrs. Thomas Clark and Co., of Elswick, and are 130-horse power, worked most satisfactorily, the speed attained averaging 10½ knots. The measured mile was passed in five minutes, or at the rate of 12 knots an hour with the tide.

R. F. Matthews.—On the 22nd May, the new screw-steamer R. F. Matthews, built by Palmer's Shipbuilding and Iron Company (Limited), Jarrow, to the order of Messrs. Hunting and Pattison, Newcastle, left the Tyne for her trial trip. The dimensions of the R. F. Matthews are as follows:—Length, 280 feet; breadth, 35 feet; depth, 24 feet 6 inches; gross carrying capacity 2,800 tons. She has been built extra strong, being over Lloyd's requirements, and she is intended for the general carrying trade. Her engines are 200-horse power, nominal. She has three decks, the main-deck being of iron; has full poop, and topgallant forecastle; her bridge being situated amidships. The vessel ran along the coast north and south, and her speed was tested, with and against the tide, over the measured mile, the mean being 11½ knots.

Medway.—On the 22nd May, the trial trip took place of the Medway (s), built to the order of Messrs. Lambert Bros., London, by Messrs. S. P. Austin and Hunter, Sunderland The dimensions of the Medway are;—Length, 226 feet; breadth, 31 feet; depth, 15 feet 9 inches. Tonnage 996 tons gross, and 641 tons nett register. She will carry 1,380 tons deadweight, including fuel, at a mean draught of 14 feet 9 inches, at an average speed of 9 knots. Her engines and boilers are of 120 nominal horse power, by the North-Eastern Marine Engineering Company (Limited), of Sunderland, with cylinders 28 inches and 54 inches diameter, 33 inches stroke, and two boilers of extra size, and are fitted with the latest improvements, including Durham's patent velometer for regulating the speed. She has been specially designed for the coal trade between the Tyne and the Thames, with long half-poop topgallant forecastle, long bridge deck, wheelhouse, and pilot bridge, with all the latest improvements, including iron decks, self-trimming hatchways, improved steam winches, with very large donkey boiler, and every requisite to facilitate quick loading and discharging. She is constructed with Messrs. Austin and Hunter's improved arrangement of double bottom, by which the framing and floors are made to contribute to the longitudinal strength of the bottom, and with their arrangement of web frames to strengthen the sides. She has water ballast arrangements of double bottom and peaks, with extra large ballast donkey and suction. She will be commanded by Captain Samuel Brown. After an enjoyable run at the trial, the greatest satisfaction was pronounced with the performance of the ship and engines, and the Medway entered the Tyne at 4 o'clock and proceeded to Tyne Dock to load.

City of Dublin.—On May 22, the iron screw steamer City of Dublin, built by Messrs. Edward Withy and Co., of Hartlepool, for Messrs. Palgrave, Murphy, and Co., of Dublin and London, made her official trip off Hartlopool. This vessel was launched April 22, and has been fitted out under the directions of Captain R. Carnegie, the Owners' marine superintendent. She takes Lloyd's highest class, and has a Board of Trade certificate, and is fitted with a pair of 150-horse power engines (being the ninth for the same owners) by Messrs. T. Richardson and Son, of Hartlepool Ironworks. The machinery worked very satisfactorily, the ship realising a mean speed of fully 11½ knots. At the end of the trial trip the vessel proceeded, under the command of Captain Walsh, direct to her port of loading, Barrow-in-Furness.

Llanarthan.—On the 19th of May, this new steamship was tried at sea with a full cargo. The Llanarthan is 264 feet between perpendiculars, by 33 feet beam, has a displacement of 3,435 tons, register 1,030 tons, and had on board 5,450 tons of cargo, and bunker coal. She is fitted with all the latest improvements for safety and quick despatch, and is built and entered for Lloyd's highest class. The engines are 143 nominal horse power, and were supplied by the Tyne Engine Works Company (Limited), Ouseburn. They are the ordinary compound inverted cylinder type, but are constructed to economise fuel, and are fitted with steam reversing gear. During the trial they propelled the loaded ship at a speed of nine knots over the measured mile, indicating with 70lbs of steam on the boilers, 695-horse power. After several hours' trial, the ship proceeded on her way to Alexandria.

Milanese.—On the 17th inst., the steamship Milanese, recently built by Mr. Robert Thompson, jun., of Southwark, proceeded from Hendon Dock on her official trial trip. The early morning was very fine, but a thick fog setting in shortly before mid-day caused the trip to be limited to some extent. The Milanese is a large steamer, her dimensions being as follows: —Length over all, 318 feet; extreme breadth, 36 feet; depth of hold, 25 feet 6 inches. Her gross register is 2,490 tons, and her nett register 1640 tons. She has been built under the special survey of Lloyd's, her class being 100 A1. The engines, of 300-horse power, have been fitted by the North-Eastern Marine Engineering Company. The vessel has three decks, two of which are laid of iron; also long poop, bridge and forecastle connected by means of gangways. On the bridge an iron wheel and chart-house has been erected. She has been built for the American cattle trade, and her ventilation has been thoroughly attended to. She has four holds, and carries water ballast in the main and after holds, and has trimming tank in the forepeak. The vessel has also ample fresh water accommodation and large condenser. A cabin is fitted up aft, with captain's and spare berths. The accommodation for officers, engineers and cattlemen is amidships, and the seamen and firemen will be located in the forecastle. The vessel has been fitted up with steam winches, windlasses, &c., all of which are on the most improved principles. The vessel having left the dock, proceeded to the south-east. The engines were run gradually up to full speed, which was attained at a working pressure of 75lb. without the slightest sign of heating. Everything gave the utmost satisfaction to the owners and their superintendent engineers, Messrs. G. and A. Hepburn, of Newcastle and Liverpool. The vessel subsequently returned to

Sunderland, to prepare for her voyage to Baltimore. She will form one of the fleet of Messrs. J. Glynn and Son, of Liverpool, and will be commanded by Captain Dewdney, late of the Zerbino.

The Vivero.—On the 23rd May this steamer went down the Clyde on her official trial trip. The Vivero is a steamer of 700 tons, built by Messrs. H. M'Intyre and Co., Paisley, through Messrs. H. E. Moss and Co., of London and Liverpool, to the order of W. E. Gurney, Esq., London. She will be engaged in the Spanish trade, under the command of Captain Lee. The Vivero has compound surface condensing engines of 70-horse power, by Messrs. Muir and Houston, Glasgow. The trial was considered most satisfactory, the vessel attaining an average speed of 10½ knots in a six hours' run.

NOTES AND NOVELTIES.

The German Commercial Fleet.—According to the Imperial statistics, the number of registered sea-going vessels in Germany on the 1st of Jannary, 1878 was 4,805, of which 4,469 were sailers and 336 steamers.

The illumination of bucys.—Pintsch's gas, made from shale oil, has been lately used for illuminating buoys in navigable channels and Mr Stephenson has now developed a system by which the mariner will be enabled to distinguish these buoys from one another,

Hughes' Salinometer.—Messrs. Henry Hughes' and Son have brought out a very complete form of Salinometer, which comprises an improved copper pot, with a long wooden handle to prevent scalding when drawing off. A gilt metal and a glass Salinometer, and a thermometer, the whole packing in the copper pot when not in use.

The new Amsterdam canal.—On the 26 ult. the vessels of the Dutch East India steam line to Java started, for the first time, from Amsterdam. Hitherto the Helder has been the port of departure. But the new canal, which now connects Amsterdam with the North Sea, enables the heaviest vessels to come alongside the quays of the capital.

The Barrow Shipbuilding Company have secured an order for the construction of four gun-boats for the Admiralty similar in build and style to the Foxhound and Forward, built in their yard a year or two ago. The company have also in hand the building of two torpedo mooring steamers for the Admiralty.

Lieutenant Durnford, torpedo officer, of the School of Torpedoes, at Portsmouth, has been directed by the Admiralty to carry out a plan he had suggested for the removal of the masts of the Vanguard by blowing them out of ship. The operations are to be undertaken during the first week in June, weather permitting.

New Lining Metal.—In Taylor's special bearing metal, marine engineers are offered a new lining metal, claimed to be equal to Kings' tin, at half the price. It is said to require less lubrication, and reduce friction to a minimum, while it possesses the great advantage of keeping cool much longer than any other anti-friction metal, in the event of neglect with part of the oiler

Life Rafts for the Navy.—The Lords of the Admiralty have directed the officers of Sheerness Dockyard to issue to ships of war when commissioned life-rafts on the principle patented by Commander Britten, R.N. These rafts are to be used in place of coppering punts, and will be used both for saving life and for cleaning the bottoms of ships. Reports are to be made on them by commanding officers.

Preparations are being made for a series of important gunnery experiments at Portsmouth. The composite steel and iron plates in course of manufacture by Messrs. Cammell, of Sheffield, for the turrets of the Inflexible have to undergo a severe test before being accepted, and this will be effected by a portion of each plate being cut off, fitted in a specially constructed iron frame on the battery at the back of the Nettle turret ship, and fired at by the 12-ton 9in. gun.

Registration of Ships.—The Board of Trade have published a list of ships reported during the month of April, 1879, to the Registrar-General of Shipping and Seamen as coming into Registry; as also of ships the registers of which were closed. We find from this return that 132 vessels were registered, of 63,580 gross tonnage, and that 149 were removed from Registry; of these latter 21 were sold to foreigners, 21 were wrecked, 8 stranded, 23 lost, 25 broken up, 15 abandoned, 4 were in collision, 8 missing, 9 foundered, 3 were burnt, 5 were condemned, and 7 struck off for other causes.

European Dock Dues.—Some interesting statistics of the expenses of a vessel of 1000 tons register passing from the ocean into the docks at each of the chief European ports, have recently been published in Holland. These expenses include pilot, lighthouse, harbour, canal, mooring, towing, and lightering dues. The cost to London is £125; to Liverpool £133; to Bristol £100; to Antwerp £98; to Hamburgh £110; whilst Amsterdam stands to-day at £81, against £187 before the completion of the new canal. On the ground of the advantage now afforded by Amsterdam in this respect, a return of the ancient prosperity of the whole Dutch city is prophesied.

Shipbuilding on the Clyde.—Messrs. Elder and Co., Fairfield, Govan, have received an order from the Government to build two single-screw composite gun vessels, to be named the Rambler and the Ranger, also one despatch paddle-wheel steamer, to be called the Niger. Four gunboats are to be built in Barrow, and the other gun-vessel is to be built by Messrs. Harland and Wolff, of Belfast. In addition to the stimulus which will be given to the Clyde shipbuilding trade by the construction of the vessels by Messrs. Elder and Co., a more healthy tone is already apparent in this industry A large number of firms in the upper reaches are busy executing repairs, and some new keels are about to be laid down.

Spontaneous Combustion.—E. Bing, of Riga, has experimented with different materials; wadding, raw flax, hemp, the waste from silk, wool and cotton spinning as well as sponge, and finally wood dust as found in any cabinet-maker's shop. They were saturated with various fluids, viz.: oils, fresh and in a gummy state; turpentine, petroleum, various varnishes, &c. All the fibrous materials took fire when saturated with any of these oils or with mixtures of the same. Sponge and wood dust, on the contrary, proved to be entirely harmless. Combustion ensued most rapidly with 17gr. of wadding and 67gr. of a strong oil varnish, in 34 minutes; while 200gr. of washed cotton waste, of which a portion was saturated with 750gr. of strong oil varnish and the remainder wrapped about it, required almost 14 hours. These materials were placed in a well-sheltered spot, and subjected to a heat of from 18° to 4° (C). Silk did not flame up, but slowly charred.

OBITUARY.

Death of Mr. William Froude.—We regret to announce the death of Mr. William Froude, F.R.S. The deceased gentleman, who had long been in a weak state of health, left England in November last year, on board Her Majesty's ship Boadicea, for a holiday cruise to the Cape, and he died of dysentery on the 4th inst., at Simon's Town. Mr. Froude, who was one of the greatest masters of applied mathematics in modern times, served on Lord Dufferin's Committee on the designs upon which ships of war have been constructed, and also upon the committee which was appointed to examine and report upon the stability of the Inflexible, turret-ship. Mr. Froude's attention had been largely devoted to investigations on wave resistances, the oscillations of ships, the usefulness of bilge keels, on frictional, air, and wave making resistances, on the ratio of effected to indicated horse power, and on the best forms of screw propellers and rudders. His elaborate series of experiments at Torquay

[illegible]

[illegible] of Dundee.—The death is announced [illegible] Davidson, Shipowner, which took [illegible] day, the 16th inst. Mr. Davidson, [illegible] son of Dr. Davidson, one of the ministers of the [illegible] Dundee, was born in Dundee towards the close [illegible] century, and was thus at the time of his death in his [illegible] year. Deceased was long well-known in Dundee, where he evinced an active interest in public affairs, especially in the harbour and shipping trade. He is said to have been the first to import jute direct from India to Dundee. For that purpose he had a ship, the Selma, built, and this vessel arrived at Dundee on the 26th of April, 1840, from Calcutta her cargo on that occassion including 850 bales of jute. Captain Luckie, a native of Dundee, who commanded the Selma, was presented with the freedom of the town for bringing the first ship which had entered the port direct from India. For a time Mr. Davidson was editor of the *Dundee Chronicle*, and also contributed a number of articles on nautical subjects to the *Northern Warder*. He removed from Dundee some years ago to Seaton Carew. He has left a widow and two sons, the elder, Mr. Alexander B. Davidson, being a landed proprietor in England, and Mr. William Davis, the younger, being Lloyd's agent at West Hartlepool.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examinations under the provisions of the Merchant Shipping Act, of 1854, during the month.

Note.—1 C, denotes First Class; 2 C, Second Class.

Hutton, Jno. ...	2 C	Greenock	Forrester, John	1 C	Liverpl.
Scott, Matthew	1 C	do.	Gilliland, Jas.	2 C	do.
Brock, W. ...	1 C	do.	Waller, Wm. ...	2 C	Dublin.
Sanderson, Jno.	1 C	do.	Carruthers, F.	2 C	N. Shlds.
Hutton, James B	1 C	do.	Graham, Thos.	2 C	do.
Simmons, Geo.	2 C	London.	Armstrong, Jas.	2 C	do.
Strachan, A. ...	2 C	do.	Stephenson, Jas.	2 C	do.
Chapman, J. T.	1 C	Hull.	Dryden, W. W.	1 C	do.
Turner, Wm....	2 C	Bristol.	Noble, John ...	1 C	do.
Bellis, John ...	1 C	do.	Johnston, Wm.	2 C	Glasgw.
M'Donald, Rbt.	2 C	London.	Johnston, Alex.	2 C	do.
Walker, John	2 C	do.	Bogle, Edwin...	2 C	do.
Turnbull, M....	2 C	do.	Leitch, Geo. T.	2 C	do.
Westland, Wm.	2 C	do.	Mackie, Walter	2 C	do.
Cornell, J. W.	2 C	do.	Gillies, John ...	2 C	do.
Heaton, Edward	2 C	Liverpl.	Hind, John H.	1 C	do.
Cant, William	1 C	do.	Blair, James ...	1 C	do.
Inglis, Niel. ...	1 C	do.	Anderson, David	1 C	do.
Malcolm, Edwin	1 C	do.	Wilson, Sam. A.	2 C	Sndrlnd.
Topley, William	1 C	do.	Dent, John ...	2 C	do.
Thomson, Hy.	2 C	Abrdeen	Gibb, James ...	1 C	do.
Crass, Thos., H.	2 C	London.	Scott, John H.	1 C	do.
M'Lean, James	1 C	do.	Nagel, Dirk W.	1 C	do.
Sticney, W. P.	1 C	do.	Grant, Roderick	1 C	do.
Thompson, J....	2 C	Glasgw.	Connon, Wm....	1 C	do.
Robinson, Jas.	2 C	Liverpl.	Allix, Hy. Geo.	1 C	London
Affleck, Robert	2 C	do.	Prentice, Wm.	1 C	Lverpl.
Owen, John ...	2 C	do.	Runciman, A.M.	2 C	Leith
Howie, Wm. ...	1 C	do.	Geekie, Charles	1 C	do.
Passabanda, M.	1 C	do.	Hope, Henry ...	1 C	do.
M'Call, M.	1 C	London.	Carver, Wm. J.	2 C	London.
Glassford, W. P.	1 C	do.	Simpson, G. H.	2 C	do.
Thornton, R. P.	1 C	do.	Hayes, Saml. A.	2 C	do.
Hodgson, Gilbrt.	1 C	do.	Gullett, Jas. B.	1 C	Plymth.
Wood, Thomas	2 C	Grenock.	Ramsay, Chas. T.	1 C	Liverpol.
Smith, David...	2 C	do.	Ormiston, Wm.	1 C	N. Shlds.
Foster, Jonathan	1 C	Hull.	Murray, Alexr.	2 C	do.
M'Farlane Davd	1 C	do.	Grant, Alexndr.	2 C	do.
Neasham, Thos	2 C	Liverpl.	Harris, Mitchell	1 C	Grenock.
Westbury, W.T.	2 C	do.	Mathieson, A.	1 C	Liverpl.

[illegible] Applications for PATENTS connected with MARINE ENGINEERING, SHIP CONSTRUCTION and MECHANICAL APPLIANCES for use in SHIPS.

Axle Boxes, W. Edwards, Birmingham, 1790.

Belt Fasteners, (a communication), G. Sonnenthal, Queen Victoria Street, London, 1834.

Belting, F. Walton, Twickenham, 1737.

Blocks and Sheaves, G. Bullock, sen., and G. Bullock, jun., Rotherhithe, 1779.

Cast Iron Constructions, (a communication) J. A. Brodie and D. Jack, Leath, Midlothian, 1824.

Cast Metal, (a communication), J. H. Johnson, Lincoln's Inn

Cleaning Ships' Bottoms, H. Studdy, Waddeton Court, Devonshire, 1963.

Copper Tubes, J. Gibbons, Birmingham, 1950.

Fields, London, 1833.

Drilling Apparatus, J. K. Gulland, Westminster, 1809.

Demagnetising Ships, E. H. Hopkins, Richmond, Surrey, 1766.

Driving Belts, (a communication), A. C. Henderson, Southampton Buildings, London, 1695.

Endless Bands, (a communication) W. R. Lake, Southampton Buildings, London, 1690.

Fire Extinguisher, (a communication), J. Imray, Southampton Buildings, London, 1656.

Fog Signals, J. W. Fowle, Boston, U.S.A. 1580.

Forging Machine, J. Hargreaves, Widnes, 1764.

Gun Carriages, G. W. Rendel, Newcastle-on-Tyne, 1630.

Hand Pumps, (a communication), L. A. Groth, Stockholm, Sweden, 1633.

Improved Valve (a communication), A. M. Clark, Chancery Lane, London, 1872.

Lubricants, F. P. Warren, Southsea, Hants, 1748.

Lubricating Apparatus, (a communication), W. R. Lake, Southampton Buildings, London, 1840.

Lubricating Machinery, (a communication), H. J. Haddan, Strand, Westminster, 1884.

Metal Nuts, T. P. Allen, West Bromwich, 1602

Motive Power, W. J. Butler, Bayswater, London, 1685.

Motive Machinery, H. P. Holt, Leeds, and F. W. Crossley, Manchester, 1912.

Motive Machinery, H. P. Holt, Leeds, 1913.

Net-Hauling Machinery, J. H. Fitzgerald, Andrews, St. Fifeshire, 1588.

Nuts and Screws, J. Cowdey, London, and H. Andrews, Hammersmith, 1740.

Oil Cans, (a communication), J. G. Rollins, Upper Thames Street, London, 1587.

Oil Lamps, H. E. N. Mason, and J. Price, Birmingham, 1609.

Pumps, J. Newton, Oldhom, and J. Cowper Ashton-under-Lyne, 1947.

Pumps, (a communication), C. Pieper, Berlin, 1722.

Punching Machines, (a communication), A. M. Clark, Chancery Lane, London, 1684.

Rolling Apparatus, (a communication), H. A. Bonneville, Paris, 1770.

Raising Ships, T. A. Dillon, Dublin.

Refrigerating Chambers, (a communication,) W. R. Lake, Southampton Buildings, London, 1905.

Rotary Engines, E. Hall, Boston, Lincolnshire, 1776.

Rotary Motion Apparatus, E. J. Besème, Brussels, 1880.

Screw Propellers, A. Morton, Glasgow, 1943.

Shaping Sheet Metal, (a communication), W. R. Lake, Southampton Buildings, London, 1598.

Ship Signals, J. Fitzgerald, Old Charlton, Kent, 1650.

Ships' Night Signals, J. W. Fowle, Boston, U.S.A., 1581.

Slide Valve Apparatus, (a communication), L. Schwartzkopff, Berlin, 1948.

Steam Boilers, J. Taylor, Birkenhead, 1636.

Steering Apparatus, G. D. Davis, Stepney, Middlesex, 1662.

Steering Machinery, C. R. Simey, Sunderland, Durham, 1586.

Steering Apparatus, G. Donkin and B. G. Nichol, Newcastle-upon-Tyne, 1819.

Steam Jacketting, C. Pollard, Accrington, 1827.

Vices, J. Pattinson, Sheffield, Yorkshire, 1664.

Valves, (a communication), J. H. Johnson, Lincoln's Inn Fields, London.

Water Velocipede, J Bramall Southampton, 1710.

Wheel Cutting Machinery, (a communication), W.P. Thompson, Liverpool, 1720

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SUBSCRIPTIONS.

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The Marine Engineer,

LONDON, JULY 1, 1879.

DURING the last week a numerously attended meeting of the Institution of Mechanical Engineers has been held at George Street, Westminster. We had hoped to give our readers, full details of the last paper which was to have been on the screw propeller, but unfortunately the time did not allow of its being read.

As it was, some very interesting papers were read. On Thursday evening attention was given to an interesting paper on the use of iron and steel in high pressure boilers, by Mr. David Greig, and Mr. Max Eyth of Leeds. The paper embodied a very large series of experiments which had been carried out by the authors, to ascertain the relative values of mild steel and iron for boilers of the ordinary high pressure portable type. Much valuable information was given and elicited in the after discussion, as to the best form of rivets, and rivetted joints. One instance very clearly shows that steel may be looked upon as now fully accredited as a material for making boilers. The instance we refer to, is, the case of two exactly similar boilers, worked under precisely similar conditions, and at the same time, one of iron and the other of steel. They were made by Messrs. John Fowler and Co., Leeds, in 1868, and belonged to 2 engines of a steam ploughing tackle. During eleven years they have given no trouble, and the steel boiler is now much the better of the two.

The following papers on Friday evening, were on the Compounding of Locomotive Engines, by M. Anatole Mallet of Paris; and a system of ejector hydrant for fire purposes in London, by Mr. J. H. Greathead of London. Both were followed by interesting discussions.

It seemed to us a dreadful waste of the country's money, when we heard a short while ago of the interesting submarine operations for blowing up the masts of the Vanguard. There is no doubt that, to be able certainly and cheaply. to use dynamite under water, for the removal of obstructions in channels or harbours, is a very valuable field of experiment, and one we shall be glad to see the Government officials expert in. Still it does seem a reflection on the mechanical ingenuity and enterprise of the country, that we can find no other way of settling the Vanguard question, than by blowing her up piece-meal. Half-a-million of money at least she represents as she lies there. Surely she would be worth raising, even if many thousands were expended in doing so. What we want is a little experience in such matters, and we should soon find a practicable way of doing it. We give particulars elsewhere of a suggested method of raising, which is worth the attention of those interested in undertakings of that description. The Vanguard was reported to be lying at an angle of 40 degrees on the Irish bank. The first attempt to blow away the masts, was by sinking a bag containing 50lbs. of dynamite into the lower rigging of the foremast. This was not attended by any effective result, except killing some dozens of fish. Afterwards, two bags each containing 50lbs. of dynamite, were inserted down the hollow iron mast, and the head of the mast was thus successfully blown away. The mainmast was attacked successfully by a 70lbs. charge, whereby a piece of the mast 40 feet long was shot high in the air. The dismasted bulk is now abandoned as all is cleared to a depth of 14 fathoms.

We have heard some indirect rumours of a new steel war vessel, that is now being built and fitted out by the Government down the river. She is to be built entirely of steel, and of cigar shape, and to act as a torpedo vessel and battering ram only. This seems a new departure in naval warfare, although we have heard some time ago of the Yankee inventor, who built two cigar vessels, now we believe at Southampton, in which he thoroughly believed as the ships of the future, so completely was the Yankee inventor possessed with this idea that he saddled the provisions of his will the stipulation that a certain sum annually was to be spent upon these vessels until a certain speed, we believe about 18 knots was attained by them. The new steel vessel we speak of is to be very heavily engined, so as to have, if possible, a speed of about 16 to 18 knots.

She will undoubtedly prove a very powerful and dangerous enemy, for we have long thought that the only safety for war vessels, in the protracted conflict between heavy guns and heavy armour, is to make them of such external shape, that the impact of the shot shall be evaded and diverted. The cigar shape will fully accomplish this end, and we should not be surprised to hear that this vessel will be able to approach ironclads for ramming or torpedo purposes, in spite of the heaviest shot directed against her. She will lie so low in the water; and what upper surface is exposed, will be so impossible to hit directly, that we do not think with a fairly stiff frame and shell, that she will be at all vulnerable. Our readers will at once see what a formidable enemy she would prove. The present defence against torpedos, is either the net to stop discharged torpedos, or, the hitherto extreme vulnerability of the launches which may be carrying them. Now such a vessel may approach in broad day light under the guns of the heaviest ironclad, and discharge her torpedo by direct contact breaking through all netting, or possessing such a superior speed to most of the ironclads she would be able to run almost at her pleasure.

Such thoughts are very startling as if they prove feasible we have spent millions on our fleet, almost in vain, and must now begin again on new lines.

We have looked out anxiously for a report as to the state of the Sultan, after the boiler so unfortunately gave out at such a critical moment of the Eastern Question.

We should be sorry to think that our navy was so unreliable that at the moment it was wanted, it should be found unseaworthy. As the Sultan was only launched in 1871 it would have been a sad look for us if she should have proved already unseaworthy, although the repairs to her hull and boilers have been extensive, new rivets having been put in where required, and her plates clipped scraped and renovated, we are still glad to find that she is again perfectly sound and a credit to our navy. We report elsewhere in this issue particulars of her trial trip which proved most satisfactory, her engines in particular reflecting credit on the makers Messrs. John Penn and Sons. They seem to be as good as ever with very slight repairs and resetting to the brasses. This point is a very satisfactory one after all the hard work and knocking about that the engines must have undergone, as the efficiency of the engines now a day's certainly given the efficiency of the vessel.

We notice also that even after the nine years wear, the cylinders did not want reboring, this brings forcibly to our notice, one valuable effect of the Penn Trunk engines. The direction of rotation is always set so that the alternate thrust and pull, on the connecting rods is always made to lift the piston and trunk not depress it. The weight of the piston and trunk, is thus almost entirely carried on the crank and the cylinder is thereby relieved so much so that we believe that what small amount of wear does show in Penn's trunk engines is at the top of the cylinder, not the bottom. Any other horizontal engine would in a few year wear oval.

THE SOCIETY OF ENGINEERS.

Between seventy and eighty members and associates of the above society and their friends took advantage of a most interesting and instructive programme which had been arranged for their benefit by the secretary, Mr. Perry F. Nursey, whose efforts were materially supplemented by Messrs. Cutler and F. E, Duckham, en gineerto the Millwall Dock Company. The members arrived at Millwall Pier shortly after twelve o'clock, and were received by Mr. S. Cutler and Mr. Duckham, members of the Council of the Society.

Mr. Duckham conducted the party over the Millwall Docks, explaining the general arrangements and working appliances, including the hydraulic engines and machinery, and pointed out that swing bridges, capstans, cranes, &c., were all worked by hydraulic power, there being altogether three miles of piping. The engine-houses were also amongst the various places visited, and it was stated that as the water was used for the hydraulic machinery, the engine was started automatically and stopped in the same way, in order to fill the accumulator. There were also two engines for clearing the dry docks, one of which was capable of pumping out 20,000 gallons per minute. Mr. Duckham explained an ingenious invention of his own—a weighing machine—which indicates the weight of goods whilst being lifted; also the pneumatic discharging dredger, invented by himself, which discharges 200 tons of mud into an adjoining field in 15 minutes. Priestman's self-acting skip, for facilitating the loading and unloading of grain, Jordan's patent hand-power rock drill, and, in fact, all the various points of interest in the dock were visited, concluding with an inspection of the iron clad corvette Orion, which is being fitted by Messrs Samuda. The party returned to town about six o'clock, and, under the presidency of Mr. C. Horsley, dined together at the Guildhall Tavern.

ON THE USE OF STEEL IN NAVAL CONSTRUCTION.

DISCUSSION ON MR. BARNABY'S PAPER. *(pp 45.)*

TWO other papers were read and discussed in connection with Mr. Barnaby's one on the "Use of steel in the construction of bridges," by **Mr. H. N. Maynard**, and one on the "Mechanical properties of iron and mild steel," by Mr. D. Adamson. The discussion, however, turned chiefly on Mr. Barnaby's.

The discussion was opened by Mr. Bessemer, who gave the meeting a very interesting sketch of the history of Bessemer steel, and especially of Bessemer "mild steel," from the time of his great invention down to the present. He said it was just twenty years since he stood in the same place to read a paper before the Institute of Civil Engineers on the same question. He referred to the disastrous results which succeeded the first announcement of his invention at Cheltenham, and to the two and a half and three years' labour he had to undergo before he could come before the world with a practical mode of carrying out his principle successfully. "He had grasped the great fact, though he had not grasped the details." When he had completed the details, Mr. Bessemer read the paper of twenty years ago, to which he referred, before the Institute of Civil Engineers, who awarded him the Telford Gold Medal for the communication. Then he came to the paper which had been read by Mr. Barnaby. **Mr.** Barnaby told them that the present was the veritable beginning of a great and inevitable change. He believed in the veritable change, but he did not believe in the "veritable beginning." He flattered himself that he had a little to do with the beginning himself, and that was many years ago. He would tell them what was done twenty years ago. He had a list of steel ships which had been presented to him by the chief surveyor of Lloyd's Register. In the early stage of the Bessemer process he was anxious that steel should be used in shipbuilding; and knowing that it had been successfully used in boiler making, he thought it would be a good thing to have it used in shipbuilding to a large extent. He, therefore, applied himself to securing the introduction of steel for shipbuilding purposes, and at length an enterprising firm took up the matter and built two stern wheel barges of steel produced at his works at Sheffield. This was in 1863. The firm were so pleased with the behaviour of the steel during the construction of these barges that they persuaded customers of theirs—the Hambro' Steam Packet Company—to have a paddle steamer of 377 tons built of this material, and this vessel, the Cuxhaven, was constructed in 1864. The Clytemnestra, a sailing ship of 1251 tons, and the Altcar, a sailing ship of 1283 tons, were also built of steel in 1864. Next year, in 1865, six vessels, of an aggregate tonnage of 5342 tons, were built of Bessemer steel, viz., the Isabel, a paddle steamer of 1095 tons; the Curlew, a paddle steamer of 409 tons; the Plover, a paddle steamer of 410 tons; the Sandan, a sailing ship of 184 tons; the Midland, a paddle steamer of 1622 tons; and the Great Northern, a paddle steamer of 1622 tons. At this point a hitch occurred in the use of steel for shipbuilding. The firm who had taken the matter up became involved in some financial difficulties and the two vessels of over 1600 tons last mentioned, which were in frame and partly plated, ran a risk of not being completed. Knowing the important results which might be expected to result from the employment of steel in shipbuilding, he was induced to supply funds for the completion of these vessels, and he put down £10,000 for that purpose. The vessels were finished, but the firm who built them had become too deeply involved, and their yard had to be closed. This caused a gap in the use of steel for ships, and next we came to two tug boats 97 and 67 tons, built in 1871-72, while next was the Isabella paddle steamer, of 1118 tons, built in 1877 of Bessemer steel made at Crewe; this vessel has its plates, angles, beams, and rivets, all of steel, and is one of those splendid Holyhead boats. These last mentioned are the "three small vessels" referred to in Mr. Barnaby's paper. Next in the list came nineteen barges built of Bessemer steel; then the Hermod, sailing ship 743 tons, built in 1878; next a light paddle-wheel steamer for the Irrawaddy Flotilla Company, then the Lanilies, the Light of the River, the Dahabiall, the Lynx, the Fox, the Owl, the Bat, the Colonel Lamb, the Wasp, the Hornet, the Rounce, the Georgia Bell, the Widgeon, the Snipe, and the Ruby. Here then we have a list of ten ships built of steel, the makers' name not registered, then nineteen barges of Bessemer steel, and thirty-two other well-authenticated ships built of Bessemer steel. This list was, as he had said, kindly made out for him by the chief surveyor of Lloyd's Registers, who, however, stated that he is of opinion that the foregoing does not include the whole of the ships built of Bessemer steel in this country. There were also eight ships of Siemens-Martin steel built in 1878; and seventeen Bessemer steel ships in the same year, and not eleven as stated by Mr. Barnaby. As to those difficulties that had been referred to, as arising in shipbuilding during the last sixteen years, he thought it extraordinary that out of the immense number of steam boilers—and he believed over a thousand had passed through the hands of Mr. Adamson, and over a thousand locomotives through the hands of Mr. Webb—they had not been met with such difficulties either in the boilers or in the engines.

Mr. Webb, of Crewe, remarked that he been instructed in the Bessemer process at the works of Mr. Bessemer in 1862, and that in his then capacity of assistant to Mr. Ramsbottom he had had entrusted to him the rolling and subsequent treatment at Crewe of the samples to which Mr. Bessemer had referred. He found that Bessemer steel, if properly dealt with, would not present the difficulties that had been complained of. He did not hesitate to say that there was no difficulty whatever in getting a uniform result from the converter with ordinary care. He had made the whole of the steel angles and plates that were used in the Isabella, and he would undertake to say that there was not a single failure in a single plate or angle of that ship.

After some brief remarks from Mr. Laing, of Sunderland, who expressed his belief in the extensive future use of steel for shipbuilding, but who stated that the employment of the material had hitherto been delayed from its want of uniformity—a defect, he added, which is now being overcome—the discussion was continued by

Mr. Denny, of Dunbarton, who said, his firm were building no less than nine steamers in steel; they had three screw steamers to class at Lloyd's, and six small paddle steamers being built of steel, and the steel used was the Siemens. He must say that they had not come across a single instance to make them doubt the quality of mild steel. He took a very hopeful view of the character of that material; for this reason, that they had themselves not only confidence in it, but it was wonderfully popular with the workmen, who prefer it to working iron, and even in the rivetting they did not find any mishap or any rivet requiring to be condemned. Regarding Mr. Barnaby's paper there was one point on which he wished to join issue, namely, his statement that unless steel manufacturers could get large solid ingots, sufficient for forging, they were not likely to have steel forging. Now, he ventured to differ with that opinion, because in a small steamer that they built for themselves they had made the forgings out of steel scrap, and they had been entirely successful. They shingled it first of all, and then worked up the blooms, and they found that that was sufficient to work up the steel scraps. So far as their steel shipbuilding had gone, it had proved satisfactory, and he believed it would do so to the end. Then another point with regard to the Bessemer steel, he might say that they had not entirely used Siemens steel but also Bessemer steel, and so far as they had gone, they knew no difference, and they were as well satisfied with the one as with the other. The Bessemer steel he had used had in fact so far to go through much harder work than any of the Siemen's, and he would explain why this was. In 1877 they built a paddle-steamer, to go on a river with many snags and many hard banks in it; her plates were made of Bessemer steel, and he had recently had a report from the engineer, giving a sketch showing where she had run upon some snags, and the engineer stated that unquestionably had she been built of iron she would have sunk. The result of this had been that the company to whom she belonged had determined to employ steel exclusively for the vessels subsequently built for them.

Mr. Kirk, Glasgow, could confirm everything that had been stated by the previous speaker.

Mr. Dixon said that there was one important point with regard to the use of steel in the construction of ships, and that was the use of steel rivets. He constructed a vessel of steel, and found after some months of work that there was a pitting of the steel plates around the heads of the rivets, which were of iron. Mr. Martell inspected it, and they could not understand it, and he hoped that Mr. Barnaby would give his attention to that. With regard to corrosion, he built a vessel 19 years ago, and he had a letter from the owner the other day saying, with regard to corrosion, there was nothing to complain of, she was doing her work perfectly well; that satisfied him that they need not fear corrosion. They had never found any difficulty in the tensile and other tests, and if the price of steel was brought nearer to iron they should certainly use it. He hoped as the price of steel came down the quality would not be reduced.

Mr. Martell, chief surveyor to Lloyd's Register of Shipping, called attention to what was termed by the President in his address the obstruction likely to be caused to the introduction of this material.

He said; That as soon as shipbuilders began to display an inclination to employ this material in shipbuilding, the Committee of Lloyd's Register gave all the assistance in their power; they sent their principal surveyors round to the chief manufacturing places, and these having reported satisfactorily on the excellence of the material, the committee immediately encouraged its use and allowed what has generally been considered a fair reduction upon iron, that was 20 per cent. Seeing, then, that they did all they could to advance rather than to obstruct the introduction of this material for shipbuilding, he hoped the President's remark about the obstruction of the "controlling powers" did not apply to Lloyd's Register.

If they condemned the use of such a magnificent material as steel they would do great injury. It had not always had a fair chance, and he would be sorry to see anything done that would prevent the general introduction and proper manipulation of this magnificent material for shipbuilding purposes. The more they saw of it, he believed, the more they would be convinced of its suitableness for shipbuilding. A few cracks of the kind that had been mentioned should not, he thought, frighten them or prevent its use, but should rather stimulate us to find out the true cause of them. Those flaws were less numerous than in iron used for an equally difficult purpose. On the subject of corrosion, his experience led him to confirm what Mr. Dixon had said.

Mr. Parker, principal engineer surveyor to Lloyd's Register, said: After the observations Mr. Martell had justmade regarding the suitability of steel for shipbuilding, he would like to say a few words as to the use of the material for boilermaking purposes. During the last two years this material has come to be used extensively in marine boilers, and, indeed, has been employed in boilermaking to a much greater extent, comparatively, than in shipbuilding; and in that time no less than 120 vessels have been fitted in this country with boilers constructed more or less of steel, while at the present moment we have between 30 to 40 sets of marine boilers being made of the same material. In the construction of the boilers of these 120 vessels there would be about 400 plates used, and if they take the number of plates that have been known to fail, it would be found they bear a very small percentage to the total number in use. The actual number of plates that have cracked, so far as he had been able to ascertain, is only ten, and of these eight have come under his immediate notice, and the surrounding circumstances of each case had been carefully investigated with a result that leaves no question as to the so-called "mysterious" fractures being directly attributable to improper or careless treatment. The failures had occurred both with Siemens-Martin steel and with Bessemer steel. So far as his experience went in the matter, he had no hesitation in stating his opinion that steel can be produced by the Bessemer process of quite as reliable a character as that manufactured by the open-hearth system, and that although some of the cases where steel plates unexpectedly fractured, have on first appearance been surrounded with an air of mystery, a closer and more careful investigation into the matter has invariably disclosed the cause to be due, not to faulty material, but rather to the manipulation that ignorant or careless workmen have subjected it to. When they recollected that out of a total of about 4000 plates, only 10 or 15 plates have been condemned and that not because of inferior material, but solely owing to negligent manipulation, the surprise will be not that they have met with some failures, but that those failures have been so few in number, and have been so susceptible of satisfactory explanations. The number of Yorkshire iron plates that would have been condemned in the same number of boilers may be inferred when it is stated that it is by no means an uncommon occurrence to reject about 10 or 12 iron plates in one boiler in consequence of laminations, which is altogether absent from a steel plate. There is just another word or two which he would like to add, and that is in reference to the question of corrosion. The experience with steel boilers has not been sufficiently full and extended to allow of any decided opinion being expressed as to the relative corrosion in iron and in steel boilers, but he was informed that there are no appreciable signs of corrosion having taken place to any unusual degree in any of those boilers—some of which have been running for about 18 months. In some cases, however, where steel tubes, have been introduced amongst a lot of iron tubes the results have been anything but satisfactory, the steel tubes being found to corrode with frightful rapidity and he inclined to the opinion that if a boiler is to be made of steel it should be constructed entirely of that material, including rivets and not a combination of iron and steel, which does not, so far as they were able to judge from their as yet limited experience give satisfactory results.

Mr. Riley, who represented the Steel Company of Scotland, and is a large manufacturer of steel by the Siemens-Martin process, said he had not come across a single instance of the failure of an angle-bar; he was not so sure about the plates. Out of a list of sixty-two vessels which had been built on the Clyde, Tyne, Tees, Thames, and the Mersey, not a single case was there of an angle having failed. He did not think it necessary to take the precautions in the working of steel that had been referred to. He agreed that the men worked the steel as easily and readily as iron, and said the vessel already built had gone through a variety of work and the steel had been well tried. Out of 2740 tons of plates used for locomotive, stationary, and marine boilers, no case of failure had taken place.

(To be continued).

CAPTAIN WARREN'S LIFE SAVING INVENTIONS.

To save human life is one of the most praiseworthy and gratifying of acts—for which the Romans awarded a wreath of oak—but how many people make themselves indirectly responsible for the absence of suitable means by which fellow creatures could save their own lives or those of others. It is lamentable to think of the loss of life incurred by the sinking of the "Princess Alice," the "Grosser Kürfurst" and many other vessels, of which the list is only too long, during the last two or three years.

It is worse still to think of all those valuable lives lost, when means might have been so easily arranged to afford them all the necessary apparatus for floating on the water, and thus of being easily rescued.

But we think it is worst of all to have the conviction, as we must acknowledge we have, that in spite of such warnings and the ease and small expense with which suitable means of escape might be provided, hundreds of lives will still continue to be lost in the same manner.

However, we shall have the small satisfaction to know that it was not for want of efforts on our part that the attention of ship owners and the public was not forcibly turned to providing for themselves and others, efficient life saving apparatus. Our Indian troopships carrying 1,300 people have 35 life belts only. The Royal Yacht has eight life buoys, the Osborne has four: very adequate means forsooth to meet the exigencies of a sudden founder.

Captain Warren has two inventions which deserve notice at our hands. One is an arrangement of life buoys round the chimney, mast, or turret of a vessel, as not to take up deck room, but which can be set free at once, giving a large number of buoys, each capable of supporting two men. The buoys when built in are arranged to occupy only 9 inches around the mast or chimney, and would give the means of supporting 350 men in the water.

Captain Warren's other invention is an air bag with a self-acting valve which can be inflated at a moment's notice, by placing the valve to the lips and blowing into the life buoy.

Captain Warren demonstrated at St. George's Bath's, Belgravia that this would suffice to support any person in the water, even a soldier carrying a rifle, as they have a buoyancy of 40 lbs.

This air-bag may be worn about the person in the lining of a hat or in the pocket.

We do not see why an ordinary hat should not be fitted with such a lining, the valve acting as a ventilator, at the same cost as now, which could be inflated immediately and used as a life buoy,—we should be glad to wear one on acquatic excursions.

All present intention of blowing up the hull of the Vanguard has been abandoned. Her Majesty's ship Valorous, with Lieutenant Durnford and party, has left Kingstown Harbour for Plymouth, taking the remaining block of dynamite. The Vanguard lightship is to be removed at once.

THE NEW EDDYSTONE LIGHTHOUSE.

THE visit of the Prince of Wales and the Duke of Edinburgh to Plymouth for the purpose of participating in the laying of the foundation stone of the new Eddystone Lighthouse has ended in a postponement of the ceremony. On Friday the waves broke over the reef in such a manner that the workmen found it impossible to make the necessary preparations, and the violence of the wind continuing during Saturday morning the idea of making even a trip around the Eddystone, recommended as a sufficient ceremonial under the circumstances, was abandoned. Their Royal Highnesses, however, were so deeply interested in the matter that they preferred waiting for another and more favourable opportunity for laying the stone itself, and promised to fix a day in August next for discharging the deferred duty. Arrangements had been made for a flotilla of yachts and steamers to accompany the Trinity boats, and undoubtedly, had the weather proved favourable, there would have been witnessed one of the most charming spectacles ever seen in the vicinity of the tempest-beaten Eddystone reef. Thousands of persons had collected at various points for the purpose of observing the departure of the many gaily-decked craft that studded the mouth of the Hamoaze. Their Royal Highnesses, disappointed in their promised trip to sea, took the opportunity of going to Oreston to inspect the works, where blocks of stone used in the construction of the new lighthouse are being prepared, and for the purpose of examining the plans of the new tower. At a quarter to 1 precisely their Royal Highnesses left, both appearing in uniform—the Prince of Wales in an undress military costume, and the Duke of Edinburgh in the uniform of an admiral of the Royal Navy. Their Royal Highnesses were accompanied by the two young Princes, Albert Victor and George Frederick, in cadets' uniform, and Admiral A. Farquhar, Commander-in-Chief at Devonport; Admiral Sir Henry Keppel, Admiral Sir Richard Collinson, deputy-master of the Trinity Corporation; Captain Fairfax, H.M.S. Britannia, Captain Stevenson, R.N., Equerry to the Prince of Wales; Lieutenants the Hon. A. Curzon Howe, Equerry to the Duke of Edinburgh, and Francis Cecil, Flag-Lieutenant at Devonport. All the officers wore service mourning for the late Prince Imperial. On the arrival at the trial platform at Oreston it was explained that the stones seen there were parts of the fourth and fifth courses of masonry, which where all fitted together as they will be at the rock. The Prince appeared to be deeply interested in the manner in which the the dovetailing was effected. The illustration of what is known as the "Lewis" mode of lifting the stones absorbed a deal of the time of the distinguished party. This is the method always adopted during the progress of fitting. The operation consists of boring a deep hole in the stone, and then there are introduced three large wedges, which are driven tightly in. In the tops of the wedges are large rings, to which a loop may be attached, and the stone is in this way swung by meansof a crane. The whole system was illustrated by one of the largest of the stones, and, to the satisfaction of each member of the party, before the stone was hoisted the young Princes stepped upon it, were swung round, and then let down with it to the bottom of the platform. This experience they evidently enjoyed. The Prince of Wales remarked as to the arrangement in dealing with such heavy stones, "It is simplicity itself." After some little time had been spent in the vicinity of the trial platform, the party were taken to witness experiments with the rock drill. Its utility is manifold, for, besides the boring of stone for "lewising," a number of holes can be drilled in a line for the purpose of making the operation of splitting the stone easier. Its action was fully explained, and, as nothing is so satisfactory as ocular demonstration, a very large stone was drilled in several places. The block chosen was a piece of granite several tons in weight. In a very few minutes sufficient holes were bored, and the ordinary cleaving gear was then applied and fitted to the holes, and the granite was immediately cloven in the presence of the Royal party. Considerable surprise was excited at the marvellous rapidity with which the work was accomplished, and admiration of the process was expressed, not only by their Royal Highnesses, but by the crowd of spectators- The party were then conducted to the end of the pier, where another very important invention was explained Without suction hose it would be almost impossible to proceed with the work. This hose is employed in pumping the water from the dam constructed at the reef for the purpose of facilitating the work, and its mode of operation was graphically shown. One of the most interesting pieces of mechanical skill remained, "the cement tester," which is in great requisition, and by means of which the character of the work and the strength or weakness of every point are accurately gauged. It may be imagined that this is regarded as a crucial item in the construction of an edifice the stability of which must be of the most unquestionable kind. The machine is not a large one, and when exhibited it was placed at the innermost end of the quarry, to which the Royal party for the second time proceeded. Stationed on a large granite block was a very simple-looking machine, and around this all the party gathered while it was in motion. The young Princes were more interested in it than in anything that had previously been shown them. A piece of Portland cement 1½ inch thick was placed in the machine and a handle turned. The number of pounds pressure on a square inch could then be accurately ascertained, the amount being indicated by a guage. For some time the handle was turned alternately by one of the young Princes, and when either stopped the number of pounds pressure was declared. As the pressure increased the handle was taken by Mr. Edmonds to prevent the possibility of an accident to one of the Princes, who then watched the gauge with keen interest. It might seem almost incredible that cement should bear so great a strain, but there was no crack until the pressure had reached 1,120 pounds, and the party were then inform that a similar piece of cement had broken on the previous day after a strain of only 1,100 pounds. The Royal party were also shown the entire plans of the building, together with the model of the basement, with the brick dams, that have been built there. After the experiments were concluded their Royal Highnesses once more boarded the Galatea yacht, steamed round the Agincourt, and made for Mount Wise, where they landed, accompanied by Admiral Keppel and Captain Fairfax; they then took a special train for Dartmouth, where they remained the guests of Captain Fairfax. In the evening the Galatea left for Dartmouth to attend on their Royal Highnesses.—*The Times.*

BLOWING UP THE VANGUARD.

A CORRESPONDENT of a contemporary supplies an interesting account of the proceedings of her Majesty's ship Valorous during th recent duty of blowing up the Vanguard, which was sunk by the Iron Duke on the Kish Bank, 15 miles from Kingstown, about four years ago, and has since been a source of danger to Shipping. The Valorous took in 2,000 pounds of dynamite off Portland, having previously embarked a party of divers and torpedoists under charge of Lieutenant Durnford. Having arrived at the scene of the wreck, two cutters were sent out to "sweep," and after some hours' work they succeeded in grappling and buoying an obstruction in nine fathoms of water. The diver soon found this to be either the fore or main top of the Vanguard. He reported that she was lying on her starboard bilge, at an angle of about 40 degs., with her head to the westward. The topmasts and rigging had all disappeared. On making his next descent the diver placed a canvas tube containing 50 lbs of dynamite round the starboard lower riggings, under the top and inside the futtock shrouds. He intended to have placed it in contract with the mast, but found the under-current too strong. On his coming to the surface again the boats were withdrawn to a safe distance, and, the firing key being pressed, a loud report, accompanied by a shock like that of an earthquake, announced the explosion of the charge. A small piece of wreckage, supposed to be a portion of the trestle tree, and some dozens of fish, floated to the surface; the fish, either stunned or dying, were easily captured by the men in the boats. The tide being now too strong for further operations, the diving party returned to the Valorous immediately after the explosion. In the afternoon the divers made another descent, and found that the explosion had only been partially successful, the starboard side of the top and the starboard rigging having disappeared, but the masts remained obstinately standing. They tried to place another charge, but the tide was making too strong, and they had to reluctantly desist. Nothing more was done until the 12th ins,, when, after one unsuccessful attempt, the diver succeeded in placing a canvas tube containing a charge of 70 lbs between the head of the lower mast and the heel of the topmast. The charge was fired, and a large piece of the trysail mast, over 40 feet in length was shot violently upwards until two-thirds of its length was above the surface. and then it fell into the water with a loud splash; a small piece of the heel of the topmast also floated up, and was secured. The complete circuit of electric cable, over 400 feet in length, was lost in the operation, the mast most probably falling on the top of it, for when the tug got hold of the end and steamed ahead, it carried away in the nip. The sweeping party went over the ground several times with a scope of sweep of 14 fathoms deep, but failed to strike anything, and when trying to recover the circuit of electric cable the diver descended to a depth of 100 feet, and did not come across anything. On the following day an obstacle was grappled with in 14 fathoms, which the divers forthwith proceeded to inspect It was apparently the same mast that had been operated on on the previous day, for the masthead had disappeared as far as the crosstrees, of which only a very small fragment remained. On their next visit they took down a 60 lb. charge of dynamite, intending to adopt the usual plan of placing it inside the mast, but on a closer inspection they found that the iron was so bulged and jagged that they had to content themselves with placing it round the mast as far as they could reach. Rapidly as they worked, they had barely time to complete their task, for after the explosion, when they again went down, they could not get near the mast, the tide being already so strong. At a subsequent descent, a charge of 50 lb. of dynamite being lowered down to them, they coiled it round the mast about 10 feet below where the top had been. After the explosion a long search failed to discover anything standing. The sweeping party repeatedly went over the spot with a scope of 14 fathoms, but did not strike anything. Later in the afternoon the sweeping party again went over the spot, but could grapple nothing. On their return to the ship, the Valorous hoisted in all the diving and mining stores, and prepared for sea. The object of the operations has been most successfully attained, more than 80 feet of water being over the highest part of the wreck at lower water springs.

AN IMPROVED PONTOON, FOR RAISING SUNKEN SHIPS OR OTHER BODIES.

It is an old and well-known saying that "there are as good fish in the sea as ever came out of it," but we might very truthfully modify it by saying that "there are as good ships in the sea as ever sailed on it." It is enough to set sober men speculating when one hears of the hundreds of thousands of pounds that annually go down to the bottom of our own immediate coasts, and that too very often in comparatively shallow water.

Does not one's mouth water at that wonderful recital by Jules Verne, "Fifty thousand leagues under the sea," where he describes the owner of the strange submarine vessel the "Nautilus" replenishing his coffers from the sunken galleons of Spain in the Bay of Vigo, which laden with gold and silver from South America, are supposed from history to be lying quietly there in the depths of the sea.

Although this particular instance may only be considered fiction there are numberless instances, known to all, where fortunes may easily be picked up from comparatively shallow water, by anyone with the means or luck to do it. The Vanguard might have been obtained as she lay at the bottom worth at least half-a-million of money for a few hundreds pound public tender, if any body had known how to deal successfully with such sunken vessels.

We give illustrations this month of an improved pontoon for raising sunken ships as patented by Messrs. Kirkpatrick and Bradley, of Little Lever, near Bolton.

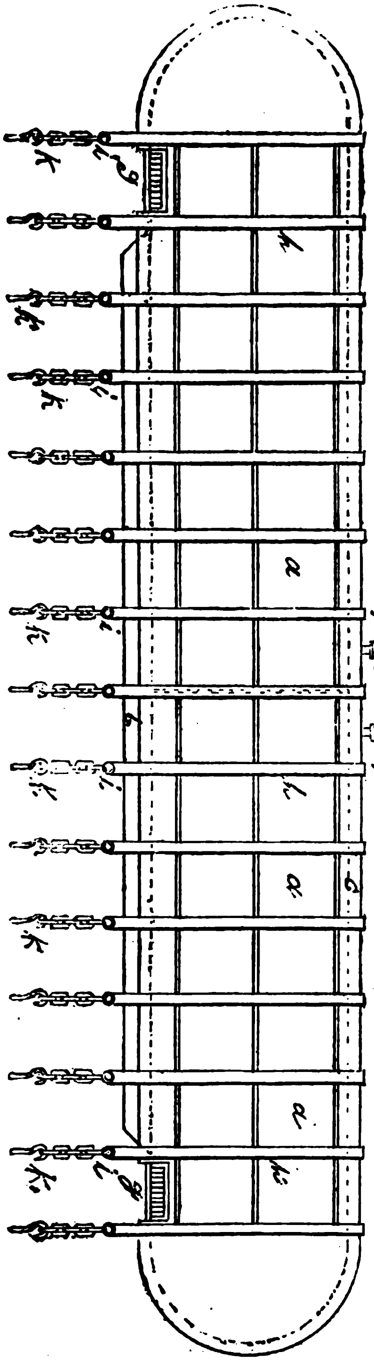
Each portion is made similar in shape to a cylindrical steam boiler, with corner ends, but formed with two or more compartments, and provided with a keel for steadying it whilst being lowered, and a wooden sheath or casing for assisting its buoyancy. At the tops of the compartments are fixed flexible pipes of sufficient length to extend above the surface of the water. Each pipe is provided with top and bottom valves, and at the lower part of each compartment there is a grated aperture for the inlet and outlet of the water. On the accompanying sheet of drawings, figures 1 and 2 are side and end views of a pontoon with two compartments, and figures 3 and 4 are end and side views representing one of the modes in which the pontoons are employed. The construction and arrangement of the pontoon valves and pipes, are such as to allow the lowering of the pontoon one end first whilst the other remains in a floating condition on the surface of the water. This will greatly assist the former when being lowered to the sunken ship and will be more easily secured by the divers. In the various figures, the body of the pontoon and the two compartments are marked A, the keel B, the wooden casing C, the flexible pipes D, the top and bottom valves of the pipes R,E, and F. and the grated apertures G. The pontoon may be made of any desired dimensions, but the one shown in the drawing is supposed to be 100 yards in length, and 12 yards internal diameter, in which case the pontoon would be made of 1 inch wrought iron plates, and would have as many 9 inch flat steel wire ropes marked H as may be required. Each rope is secured around the pontoon by links I to which are attached chains with hooks K, to fasten to the sunken ship. The cubic capacity of the pontoon is about 305.363 cubic feet, equal to about 1,897,712 gallons when full of water. When the pontoon has to be submerged to the sunken ship, the pipes having been attached to the forcing air pump (worked by steam) and all pipes secured to the valves E,F, by clamps, the valves F, are attached to the pontoon, and one of the valves E and R, is opened to allow the internal air to escape through R, the pontoon is thereby caused to sink and be moved to any desired place for attachment, and after this is accomplished E closed and E2 opened, and the end which was left in a floating condition at the surface will be greatly assisted with the first that was lowered to the sunken ship. The next operation is to discharge the water from the pontoon. The valve R being closed, and E and F still open, the forcing air pump (worked by steam) is then set to work, and the compressed air forces the water out of the pontoon through the grated opertures G, the air taking the place of the water. Whilst the operation is being performed, the pontoon becomes a raising power to the extent or in proportion to the quantity of water forced out and air pumped in. The length of cylinder of air pump is 6 feet and internal diameater 5 feet, which represents 117 gallons in cylinder, forcing 4,685 gallons per 40 strokes, or forming a raising power equal to 23 tons per minute, or in 6 hours 8,280 tons. By using two pontoons, a raising power equal to 16,560 tons will be obtained in 6 hours.

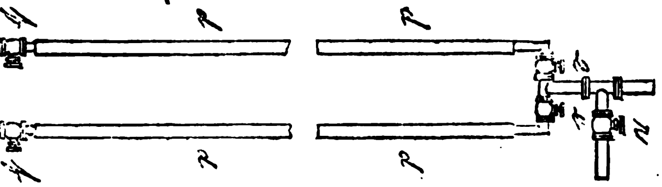
The whole arrangement seems very simple and easily worked provided the attachments to the sunken hull can be easily made. It is in this point that so much difficulty is experienced; we are not sure that Messrs. Kirkpatrick & Bradley have completely solved the question.

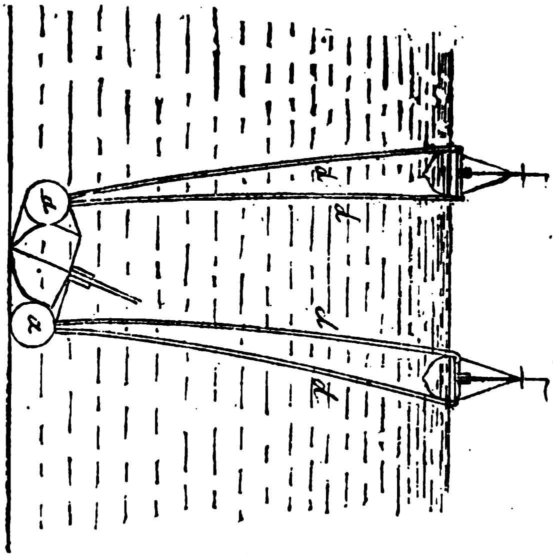
The "Inflexible,"—The first testing of the 9-inch composite iron and steel plates, similar to those intended for the turrets of the Inflexible, now in course of completion at Portsmouth, commenced on Wednesday on board the "Nettle," in Portsmouth Harbour. The plates are of a thickness of 3½ inches of steel and 5½ inches of iron, the steel being the outer surface. Three shots were fired from a 12-ton gun, each shot being propelled by a charge of 50 lb. of powder. The distance from the muzzle of the gun to the plates was 30 feet, and after three shots had been fired some seven or eight cracks were found in the plate. The wooden backing of the plate will not be removed for a few days, and the actual amount of damage inflicted upon the plate, and the extent of the penetration of the shots, will not be definitely ascertained until this has taken place. It was considered from the casual inspection which was made that the plates passed a satisfactory test. Three other plates for the turret are awaiting a similar test, and the remainder have to be delivered by the manufacturers, Messrs Cammell, of the Cyclops Works, Sheffield

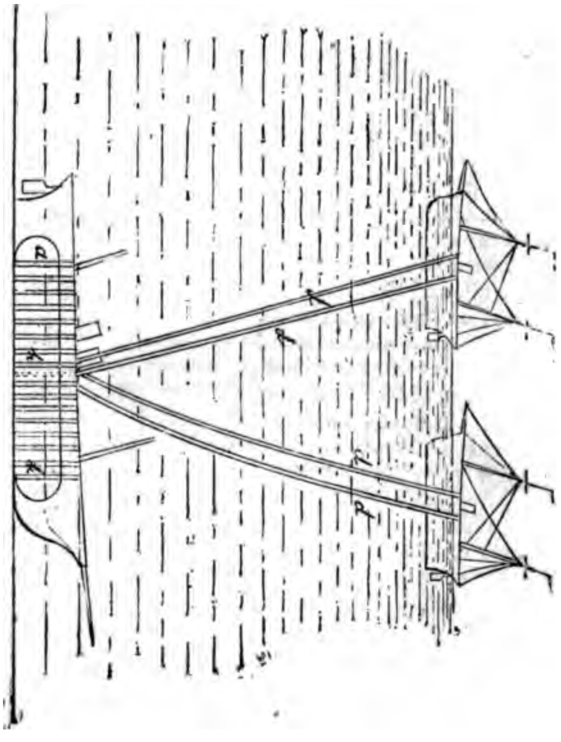
New Turret Ship.—The preliminary work of building the *Colossus* has been commenced at the Portsmouth Dockyard, the flat keel and the vertical keel, together with most of the frames having been completed, but the putting in of the first rivet has been temporarily postponed, this interesting task having devolved upon the First Lord of the Admiralty, or his niece. This twin-screw turret-ship, with a central armoured citadel, will be a reduced *Inflexible*, her principal dimensions being 325 feet in length between perpendiculars, 68 feet in extreme breadth, and 6150 tons displacement. She is to mount four guns, to have an indicated horse-power of 6000, and her hull is estimated to cost £450,000, while she is to be advanced during the year 820 tons, at a cost for labour of £28,000.

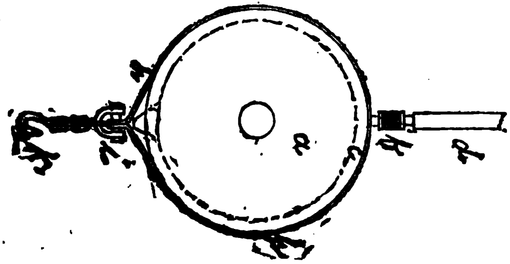
AN IMPROVED PONTOON, FOR RAISING SUNKEN SHIPS OR OTHER BODIES.











OF THE ANALYSIS OF COMPOUND INDICATOR DIAGRAMS.

By Mr. David Purvis.

(Read before the Association of Marine Engineers, Liverpool.)

I HAVE the honour of drawing your attention to the subject—the interpretation of Compound Indicator Diagrams. My purpose is to offer some suggestions on a method of reading them, by which we may usefully and accurately ascertain their meaning.

Before, however, commencing my subject let me acknowledge my indebtedness to Mr. J McFarlane Gray, for what I have learned respecting the action of steam within the receiver, and if you observe that my suggestions contain anything new, beyond what Mr. Gray has laid down, I beg you to receive it with caution. In following a mind like his, of original and penetrating power, there is small hope of finding anything new which he had overlooked. The chances are that the mind of inferior power will be misled where he walked safely. As far, then, as I follow Mr. Gray all is right, but where I depart from him, it would be well for you to convince yourselves that I am right by your own investigations, for I have generally found that, beyond what he demonstrated respecting the action of steam in the receivers of compound engines, the speculations of others have been certainly wrong. I merely desire to give hints to explain and simplify what Mr. Gray has shewn us, without any thought of surpassing him.

I intend to show graphically, from a single pair of diagrams, the action of steam as it passes through the receiver. The No. 1 diagrams were taken from an inverted cylinder engine, pistons moving together. I have worked only from one end of the cylinders, with the purpose of avoiding a crossing of lines, and I shall endeavour to shew what portion of the power is obtained from steam expanding a given number of times, and account for the difference between this and the theoretical result. A few remarks will not be out of place here respecting a number of diagrams which I have been lately looking over, when I desired to select a pair that I could rely on for correct results. Some of these diagrams showed an atmospheric pressure of more than 16 pounds, and the initial low pressure higher than the terminal high pressure. I found, also, that the lengths of some of the others were out of all proportion to their breadth. They all varied in length, more or less (I mean those that should pair); but there was one feature common to them all, and that was that the barometric height was not stated on any one of them.

I have experienced some difficulty of having no statement of the amount of clearance. I have added lines to the diagrams to illustrate the system of measurement. For instance, take any two points v. and e. in the compression curve. From e. let a perpendicular fall on the zero line, draw y. w. parallel to v. c. This gives the clearance e. w. equal to ·06 of the capacity of the high pressure cylinder.

The number of times the steam is expanded in a compound engine is equal to the capacity of the high up to the point of cut off, divided into the capacity of the low; or to give this a broader signification, it is equal to the last cylinder full divided by the high capacity up to the point of cut off. In this diagram the high cut off takes place at ·64 of the stroke, and the ratio of the pistons is 1:36; so that the steam is expended $\frac{36}{64}$=5·6 times. Now, expanding steam 5·6 times in a theoretically perfect engine—that is without loss and perfect vacuum in the cylinder—we should get a co-efficient equal to 1 † hyp. log. of 5·6, which is equal to 2·72*. That is the work given out by the steam up to the point of cut off is equal to one, and the remainder is due to the expansion. We shall now calculate from the diagrams how much of this 2·72 is realized in the engine, that is, we shall find the co-efficient of efficiency. It is equal to the total mean pressure all referred to high piston, divided by the due high terminal. To get at this terminal pressure we must measure the steam before any of it disappears from the diagram, and the best point to take it is a little before the exhaust in the high cylinder. For instance, at ·8 of the stroke it is 50 pounds pressure; then, ·8 × 50 = 40 lbs. Or it may be more correctly found thus—measure the length of the high pressure diagram anywhere you please between the compression and expansion curves, express this as the decimal of the stroke, and multiply it by the presure at that position. The length of this diagram between these curves, at a height of 47 pounds pressure, is ·85 of the stroke, and thus we get ·85 × 47 = 39·95 as the true high terminal pressure. There are several reasons why it is more correct to work from the high instead of the low terminal pressure to find the co-efficient of efficiency. One very important reason is the weight of the atmosphere, which should always be noted when taking diagrams. If the height of the barometer is not known, the depth of the zero line below the atmospheric line is generally taken at 14·7 pounds. It may, however, frequently happen that this is half-a-pound too high or too low, and the measurements from it are for this reason rendered valueless—the proportionate effect of the error being much greater if the measurement be taken at the terminal low pressure. For example, let us suppose the zero line to be half-a-pound too high, then in a measurement of 8 pounds pressure this will induce an error of 6¼ per cent. whereas, calculating from a terminal high of 40 pounds, the error produce would be 1¼ per cent. only. I have found the mean pressure of the diagrams by three ordinates. The usual method of measuring the mean by ten ordinates is a very slow and tedious process. The system I wish now to bring before your notice gives very ready and exact results. If we take the mean of each half of the diagram by inspection, the mean pressure is then found to lie between where the straight line joining these points cuts the centre ordinate. Engineers who have looked into this matter know that the area of diagrams only approximately represents the power given out by the engines. I know

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*Note.—Engineers who have obtained Board of Trade Certificates under the new questions will find no difficulty in working out this co-efficient by the usual method, thus—

0—·0500 $\frac{1}{56}$=·1785 cut off;
1—·1000
2—·0892 also ·1785=terminal pressure.
3—·0595
4—·0446
5—·0357
6—·0297
7—·0255
8—·0223
9—·0198
10—·0089

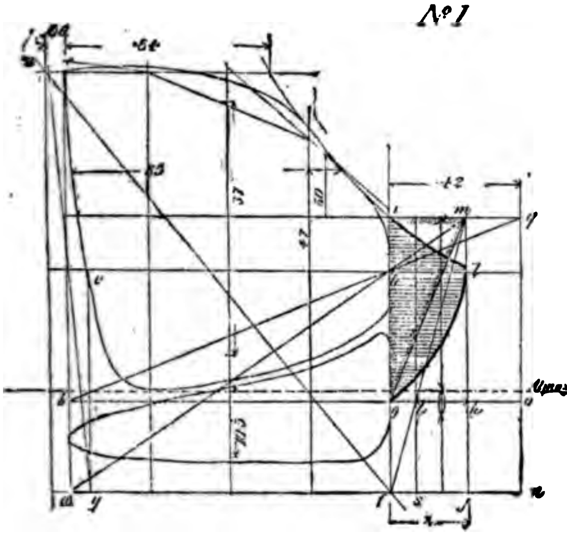
·4852 mean pressure.

$$1 \dagger \text{Hyp. Log. of the ratio of expansion.} \Big\} \frac{\text{Initial} \times \text{mean pressure by Gray's method.}}{\text{Terminal pressure.}}$$

$$= \frac{1 \times \cdot 4852}{\cdot 1785} = 2\cdot 72$$

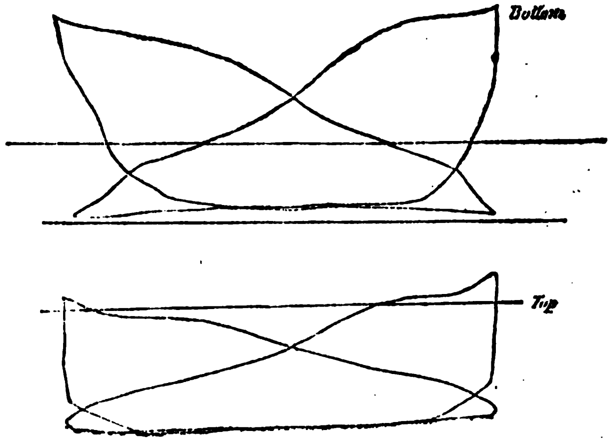
COMPOUND INDICATOR DIAGRAMS.

N° 1

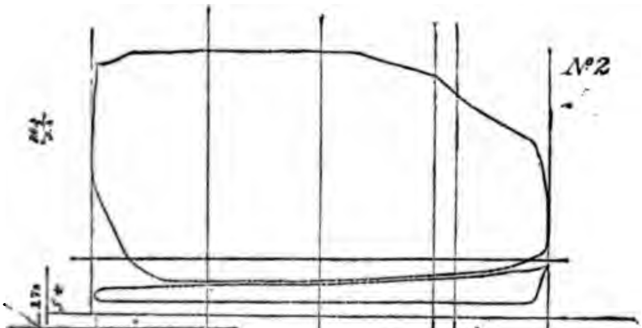

.64
.83
.37
.50
.47
.42
Atmospheric Line
m
l
q
o
n
g
.115

N° 4

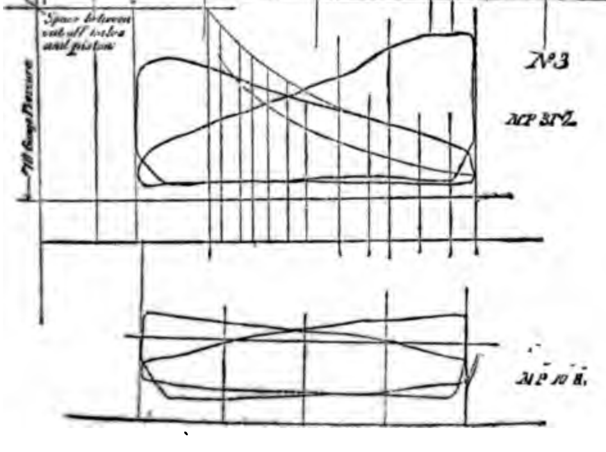
Ratio of Piston 3.6

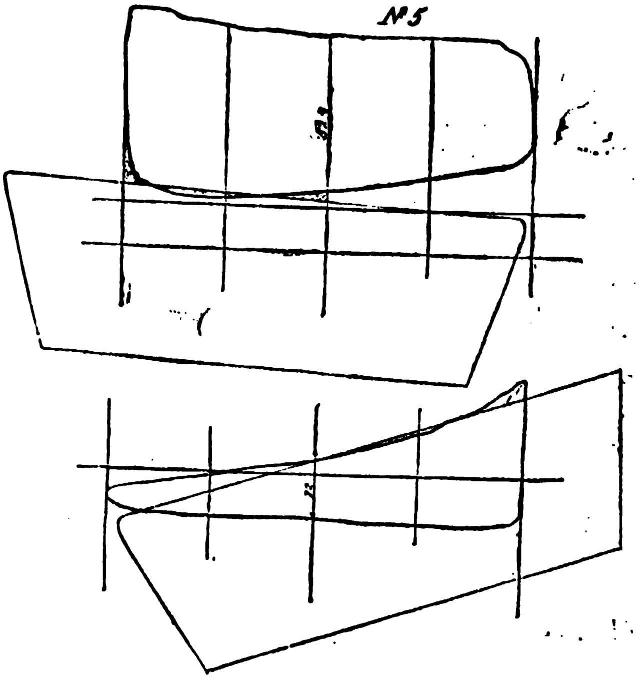


N° 2



N° 3


Space between cut off valve and piston
Gauge Pressure
MP 31.2
MP 10.8



some engineers are very careful to carry the horse power into the second place of decimals, and look upon a pair of cards with some degree of satisfaction, with their scored appearance, with sometimes 16 or 20 ordinates At the same time the indicating apparatus is likely to be 4 or 5 per cent. out—that is in a pair of engines indicating 3000 horse power, instead of being within $\frac{1}{300}$, we may be more than 100 I.H.P. out of the actual power given out by the engines.

The mean pressure found by the three ordinate method on low piston is 10·5 pounds, or equal to 10·5 × 3.6= 37·8 pounds on high. This added to the mean found on high, and divided by the high terminal, gives us 1·87 as a co-efficient of economy, thus $\frac{10\cdot5 \times 3\cdot6 + 37}{40} = 1\cdot87$. But with an earlier cut off in high cylinder a co-efficient of 2 is obtained from these engines. The difference between these two co-efficients, 2 and 1·87, is ·13, this is equivalent to 7 per cent. of the total effect of the steam, or to the total weight of coals consumed. If we take the consumption on a voyage of say 6,000 miles to be 1,100 tons, 7 per cent. of this would amount to 77 tons, the value of which we may put down at £45—an item I think is worthy of some consideration.

The receiver loss is due to the steam expanding, or the pressure in falling is arrested at i. equal to 40 pounds. The left steam in the casing g. o. n. f. has been compressed from the cut off pressure g. in the low to the pressure l. The steam which filled the high cylinder now fills the high + a part of the casing equal to h. l. j. f. The receiver also contains the compressed left steam at the same pressure l. The work due to the lost expansion is i. l. j. f., the work done and stored up by it is g. l. f. j., and the part absolutely lost is i. l. g. Now, as both sides of these curves are concave on top, we may without error consider them both straight, since the one will partly balance the other. To simplify the notation the terminal high and the high capacity are each taken equal to 1. We can now express the era of the triangle of loss in terms of pressures thus:—The area of the triangle i. l. g. is equal to half the product of i. g. and i. m. The letters i. h. and g. represent the pressures of the high terminal, initial low, and low cut off; then by the notation a. f. is equal to 1, and if we put z. equal to f. g., we get by similar triangles 1 : h : : 1 + z : i, and from this proportion $z = \frac{1-h}{h}$, but this multiplied by $\frac{1-g}{2}$ is the area of the triangle of loss i. l. g, that is $\frac{(1-h)\ (1-g)}{2h}$, or, in plain words, it is the product of the (terminal high—initial low) and the (terminal high—the low cut off), divided by twice the initial low pressures; this gives the receiver loss in pounds on high piston. The pressures on the diagram are 40,32 and 13; by substitution we get $\frac{(40-32)\ (40-13)}{2 \times 32} = 3\cdot37$ pounds, or, in terms of the co-efficient, it is equal to 3·37 ÷ 40 =·084, as loss of potential energy.

The relation that exists between the size of receiver, receiver loss, and the three pressures, viz., terminal high initial low, and low cut off, may be shewn thus:—We have given five items; if any three be known we can find the others; for example, when the three pressures are given, we can find the capacity of the receiver and its loss thus:—Join b: h. and produce it to q.: This gives receiver capacity i. q., equal to ·42 of high cylinder; and to find the loss produce a. h. to m., join m. g. and m. f. The triangle i. m. g. also represents the loss, because it is equal to the triangle i. l. g., being on the same base and between the same parallels. The half of t. k., divided by a. f., gives us the loss in terms of the co-efficient: for instance, on this diagram it measures $\frac{1}{4}$ of an inch. and the length of the high diagram measures 3 inches, therefore $\frac{1}{4} \div 3 = \frac{1}{12} = \cdot083$ of a loss—a result we have already arrived at in another way, by calculating from the pressures. The graphic method of computing loss can be proved thus:—The triangle i. m. j. is equal to half the rectangle i. k., and because the rectangle i. k. is equal to the rectangle s. m., the triangle i. m. g. is, therefore, equal to half of t. k × 1; because the terminal m. g. is equal to 1, we get this dimension in terms of the co-efficient.

The part of the question we have to deal with next is the mean back pressure on the low piston. I find this measures 6 pounds, or equal to, on the high piston, 6 × 3·6 = 21·6 pounds, and in terms of co-efficient 21·6 ÷ 40 = ·54 pounds. Now, adding these three results together we have found we get the above statements in a condensed form thus:—

Co-efficient realized	1·87 =	68·75	per cent.
Receiver loss	·084 =	3·09	„
Back pressure loss on low piston	·54 =	19·85	„
	2·494 =	91·69	„
Hyperbolic effect	2·720		
Losses unaccounted for--that is, wire drawing of steam through passages, clearance loss, &c...............	·226 =	8·31	„
		100,00	

No.	1	2	3	4	5	
Scale of diagrams.	1/32	1/48	1/32 1/24	1/20 1/48	1/33 1/26	
Gauge pressure.	...	57	70	60	70	
Ratio of pistons.	3.6	5.6	2.8	3.6	4.5	
Terminal high.	40	48	32·4	22·3	66	
High mean pressure.	37	53	31·2	27·8	52·5	
Low mean pressure.	10·5	5·4	10·8	8·8	12·	
Mean pressure all referred to High.	74·8	83·	61·44	56·	106·5	
Number of times steam is expanded.	5·6	7·7	10·	11·	5·	
Perfect co-efficient—that is without any loss from steam expanding a given number of times.	2·72	3·04	3·3	3·39	2·6	
Co-efficient realized.	1·87	1·73	1·89	2·6	1·61	
Co-efficient of efficiency.	68·75	56·9	57·3	76·7	61·9	Per Cent.
Loss through unbalanced expansion between cylinders.	3·09	7·3	8·5	2·6	13·8	
Back pressure loss on Low piston.	19·85	16·6	14·9	2·4	3·9	
Unaccounted for losses--that is wire drawing of steam through passages, clearances, &c.	8·31	19·2	19·3	18·3	20·4	

Messrs. James and George Thompson, shipbuilders, Glasgow, have received orders from the Union Steamship Company for a new steamer for the Cape of Good Hope mail service. This vessel will be larger than the Arab, lately built by this firm for the same company, her dimensions being 365ft. in length 42ft. breadth, and 32ft. in depth.

PATENT MARINE BOILER AND PATENT STEAM WINCH.

Mr. Thos. Archer, jun., of the Dunston Engine Works, Dunston-on-Tyne, has patented a marine boiler and a steam winch, which promise, from the manifest advantages they possess, to find considerable favour among the shipping community. Both inventions are in operation at the works, where they may be seen on application to the patentee. The boiler is designed to economise space, to do the work of the vessel with a less thickness of external plates, and consequently, thus to increase its carrying capacity. The manner in which Mr. Archer has accomplished these objects is exceedingly ingenious. The internal arrangements of the boiler are, roughly speaking, of the ordinary description ; it is in its outward form that the patent lies. Instead of the usual large cylindrical chamber, Mr. Archer constructs a series of small cylindrical chambers; or to describe it less technically, he really makes the shell of the boiler assume the form of the letter ⊏. It will easily be seen that a boiler turned up in this way occupies less space than if it were laid at full length in the steamer. The lower stem of the letter represents that portion of the boiler which contains the furnace ; the back of it, the combustion chamber ; and the upper stem, the various tubes. By this arrangement, the inventor claims that with the same heating surface a much less weight of iron is required while maintaining the same relative strength to resist pressure, and that, therefore, the first cost of manufacture is considerably lessened. A less quantity of contained water, too, is needed when in working order ; and this, combined with the diminished weight of material, increases accordingly the carrying power of the vessel. Mr. Archer also claims for his boiler that it can be more easily cleaned and repaired than can boilers of ordinary construction, and he considers it an invaluable part of it that screw-stays, which frequently give so much trouble, are entirely dispensed with, while the heated portions of the boiler are left free to expand. Being circular in form, it receives the pressure equally. Mr. Archer adds that this boiler, having its heating surface more advantageously distributed, the labour of firing and the consumption of fuel are reduced. Mr. Archer's patent steam winch is in operation on a number of vessels. It is a modification of the usual winch, having only one in place of two spindles. By an admirable and simple contrivance, the winch can be made to " whip " out cargo with extraordinary rapidity, or by a slow motion can be caused to lift the anchor or the most ponderous weights. The two motions can be made to follow each other momentarily. There is no chance of the weight " running," for, by the use of Napier's patent brake, it is under perfect control, and can be guided with the nicety of a steam hammer. The winch takes up less space and has fewer working parts to get out of order, and much noise is avoided by reason of the " link motion " being dispensed with. Mr. Archer also claims for his winch that it is more simple to work than the ordinary winch; and the volunteered experience of his invention, he states, goes to show that it can be perfectly controlled after a few hours practice by any hand on board.

THE First Lord of the Admiralty, Sir Cooper Key (the hydrographer), and Lord Charles Scott have met and decided the course to be taken by the Bacchante in her forthcoming cruise, and the Officers to be appointed to her. The young Princes will visit in the course of their voyage most of our colonial possessions.

ALDERMAN'S PATENT CAPSTAN AND STOPPERS.

SHIPS are daily becoming more and more the creation of engineers' brains rather than those of shipwrights and carpenters. First, the very hulls have become more nearly boiler makers' work than shipwrighting. The engineers and engines are rising daily, we are glad to see, in importance, and wherever one looks on a well-appointed vessel the observes must be struck with the mechanical ingenuity of the variour contrivances to ease the sailor's labour or add to his comfort.

Fifty years ago, our navy would have been horrified at the idea of hoisting sails or weighing anchor by any other means than the manual labour of the sailors; now, we expect, they would grumble if they were asked to do such a thing.

The old capstan with its widespreading bars is rapidly becoming a thing of the past, and now, the heavy anchor is weighed with the ease of a feather by a powerful steam crab or windlass.

There are, however, still many points in which improvements may be made, even in modern mechanical appliances. Take for instance the modern cable, there must be still room for great improvement when we read of such accidents as those recently on board H.M.S. Hector, in which five men and two boys were seriously injured. On H.M.S. Lore Warden, when two men were killed and three injured; and on board the China, at the Cape, when the roller of the main-deck capstan was carried away and two men were killed and eighteen seriously injured.

These accidents are generally caused either by the cable slipping free from the hauling capstan and thus maiming some sailor standing by ; or by the cable on slipping from the grip of the hauling capstan, paying out at enormous velocity by the heavy weight of the chain and anchor.

Mr. Alderman has invented a most valuable windlass and capstan, (which we shall illustrate in our next number,) The cable is passed round the end of the windlass or body of the capstan, whereby the cable is held in the chain-wheel and the possibility of surging or running out prevented. There being neither guide rollers nor riding bitts the accidents above referred to cannot occur.

A most valuable arrangement in the capstan and windlass is, that the hauling grip and the plain drum are made loose and separate on the same axis, and only clipped together, when hauling in, by a friction grip. The position of the guides or stoppers are also so arranged to the capstan or windlass, that so long as the cable is being hauled in, it remains securely held in the grip of the windlass ; but so soon as it is desired to pay it out the cable transfers itself to the plain drum and the cable paid out as on a riding bitt. The speed of paying out may be regulated by the after-compressor.

As the cable can, thus, with ease be purchased in, or paid out, at will, from this improved capstan or windlass, the cable may remain with always a turn round the capstan or windlass ready for paying out or purchasing in, and thus cannot surge or run out. As the cable is so securely held by a complete turn round the capstan or windlass, no danger of flying out is experienced from large links or shackles.

In some cases where a vessel has lost part of her cable, she has to put up with the nearest size she can obtain at whatever port she may be lying. By the old system, a change of size in the links would probably produce an accident when hauling. The convenience and safety of Alderman's capstans and bow-stoppers have been thoroughly approved by many shipowners.

THE CYCLOIDAL SCREW PROPELLER.

IF there is one branch of engineering in particular of which little is understood on hard and fast scientific principles, it is regarding the proportion and design of screw propellers. The actual results from similar vessels and conditions, but with different propellers is sometimes, most startling and unexpected by the builders or engineers. A vessel of beautiful design in itself and well engined, may steam at no better speed than the veriest tub if not fitted with a good and suitable propeller.

A good deal of attention on this point was drawn to the results from the "Iris," which at first entirely disappointed her designers in the matter of speed, but afterwards even surpassed them by an altered form of propeller. This "per-se" is not surprising, as in the propellers first designed and applied, there was no escape for the back water, and the driving results were almost nil.

What, however, is the point to be noticed and profited by, is, that the final splendid results in speed obtained from the "Iris" were due to experimental improvements, rather than to any conception as to why the first result was so bad, and the last so good. We ourselves are acquainted with cases in which a vessel or steam launch has actually benefitted in speed by the loss of one of the arms of her propeller. On the other hand, cases are equally numerous where an increased area of screw or a modification have also greatly increased the speed of vessels or launches. Are not these cases reducible to a law? They should be!

A case in point we extract from the pamphlet of Armit's Patent Screw Propeller. An electrically steered torpedo has been invented by a Colonel Lay who contracted with a foreign goverment that his 9 horse-power torpedo should have a minimum speed of 8 knots an hour.

The first applications of English and American propellers of all descriptions, gave only a maximum speed of 7¼ miles an hour. It was not until the Cycloidal screw of Lieutenant Armit was applied that Colonel Lay succeeded in driving his torpedo at 8¼ knots an hour, and thereby completed his contract.

The Cycloidal propeller has therefore by this and other similar results proved itself particularly worthy of credit as a first rate screw.

Its principle of construction is founded on the use of the cycloidal or rolling curve, by means of which the inventor traces both the leading and trailing edges of the screw blades and by this means he in some cases produces the largest surface area at the extremity or points of the blades. The centre of effort is brought to a point which is moving with the greatest degree of effect. The curves developed are determined by the curve of sines. This produces a blade concave on its leading driving quadrant and convex on the following quadrant.

The concave entering face produces a remarkable clean cut to the screw, so as to diminish and almost remove vibration. The flat bladed screws which are so common in our mercantile, marine, and navy strike the water with a very considerable shock, which, besides the waste of energy involved, jars the whole frame of the ship, the shaft and the engines. We should hear less of broken shafts if there was not so much jar from the propeller.

In looking over numerous official reports we find the dimunition or almost total removal of vibration is universal. In many cases an increase of speed is borne testimony to or a similar speed as before with decreased speed of engines. This must mean economy of full and saving in wear and tear of engines. We must not omit to notice one important property of this propeller. From its particular form it grasps the water very securely, thereby giving ample driving power at low speeds and also offering a very large surface area fore and aft. This has such a marked effect, that when a vessel fitted with it stops her engines the drag of the screw perceptibly aids in pulling her up. And when reversal is required the action of this screw is very prompt, enabling the vessel to go-a-stern with great celerity, and to answer her helm as well as when going ahead.

This is of the utmost importance to all vessels, as in many cases collisions might be avoided by such promptitude. For ramming and retiring in vessels or war this property is invaluable and should cause this propeller to be very largely adopted in our navy. We notice a very successful trip run by Lord Alfred Paget's steam yacht "Amy" fitted with this propeller and on which the results appeared to be highly satisfactory, while his Lordship's yacht "Dida" recently led the way during the Ocean yacht race, and showed her heels to all the steam yachts present, including Mr. Thomas Brassey's famous "Sunbeam."

The Trinity Engineers, with a party of workmen, left Plymouth on Monday June 23rd for the Eddystone Reef, and managed to land through the surf and get some work done. They found that, although the waves of Saturday dashed as high as the lantern gallery of the present lighthouse and swept over the masonry at the new structure, nothing was disturbed. Her Majesty's gun vessel Firefly, which went out in the Channel for a trial trip of her engines, was on several occasions completely swept by the sea.

H.M.S. SULTAN.

The Sultan, armour-plated ship, which was disabled through the giving-out of its boilers at the critical moment when our relations with Russia might have led to hostilities at any moment, is now in a fair way of being soon added to the effective strength of the Navy. Launched at Chatham on the 31st May, 1870, and provided by the Messrs. Penn, of Greenwich, with a pair of horizontal trunk surface condensing engines, she was long regarded as the crack ship in the service, and was selected by the Duke of Edinburgh when required to make up his sea time in the Mediterranean; and though she is now surpassed, as regards size, thickness of armour, and power of guns, by many of our modern ironclads, she continues one of the most formidable and seaworthy cruisers in the Navy. She is protected with 9-inch armour, mounts eight 18-ton and four 12-ton guns, and has realised over 14 knots per hour on the measured mile. Owing also to her cellular method of construction, she is enabled to carry weights exceeding the weight of her hull to the extent of 900 tons. At the end of her last commission she was found to be in such a state of dilapidation as regards her hull and boilers that she was despatched to Portsmouth for extensive repairs, the Duke of Edinburgh taking over the command of the Black Prince. But while all the necessary repairs and renovations have been made, the opportunity afforded by the refit has been taken advantage of to provide the ship with all the modern appliances and engines of war, so that when next she hoists the pendant she will be a more powerful and efficient cruiser than when she was first commissioned. As a matter of course, all the defective rivets in the bilge, keel, and rudder have been taken out and replaced, the whole of the plating has been scraped, chipped, and renovated, and the fittings to the cables, anchors, rigging, and masts have been thoroughly examined. The whole of the store-rooms, shell-rooms, and magazines have been completely refitted and altered, to suit the requirements of the improved projectiles, which are somewhat larger than those formerly carried, and have gas-checks attached. An engine-room, store-room, and magazine have been built for the Whitehead torpedoes, of which the Sultan will carry 12. Racers, carriages, and transporting trolleys have also been fitted, and five torpedo ports have been cut through the armour on the main deck, two forward on the mess deck and two aft in the cabins. Arrangements are also being made to mount six Nordenfeldt guns on the gunwale of the ship—two forward, two amidships, and as many aft—while a couple of Gatlings will be fixed in the tops. It is also intended to fit nine 20-pounder torpedo guns on the upper deck, and on the deck above the upper battery, for the purpose of repelling torpedo attacks. Additional magazines have been erected for the storing of outrigger torpedoes and their gear, and a couple of torpedo boats will be carried above the upper deck. It is also proposed to adopt a suggestion made by the Duke of Edinburgh and build a conning tower over the central hatchway over the box battery. The Downton pumps have been supplied with improved valve suctions into the double bottom, the steam capstan and steam steering gear have undergone repair, one of Shand and Mason's pumps, capable of getting up steam in 10 minutes, has been placed on the lower deck for pumping out the water from the double bottoms, and it is intended to fit one of the same firm's fire-engines on the same deck. The ship will also be provided with two of Wilde's electric lights, the machines for which will be worked by one of Brotherhood's engines. An attempt has also been made to improve the ventilation of the engine-room and lower deck, which was always very defective; and although additional fans have been fitted and a cowl has been erected several feet above the hammock nettings, and connected with the stoke-hole, there is still room for further improvements being introduced.

The whole of the machinery has undergone a thorough overhaul by Messrs. John Penn and Co.. of Greenwich, the original contractors. The main engines are of the same type as those which were manufactured by the same makers for the Bellerophon Hercules, Devastation, and some others of our first class ships of war, including the Neptune, the most powerfully-engined ship in the service, and which have the advantage of lying flat on the engine-room floor and consequently well below the water line. The cylinders are each 127 inches in diameter, the trunk being 47 inches, thus giving an effective diameter of 118 inches. The stroke is 4 feet 6 inches, and the engines have developed 8,629-horse power, or as many as over 1,400 horses beyond the contract. The wisdom and the expediency of providing our powerful armourclads with superior machinery, at whatever cost in the first instance, are proved by the fact that the Sultan's engines, after nearly ten years of constant use, are to-day equally as efficient as when first placed on board. Notwithstanding the commissions through which they have passed, the cylinders were not required to be "trued" and only the junk rings and gudgeons needed to be renewed. The engine frames have been re-bored and the brasses have been "trued" and re-adjusted throughout the length of shafting. This is nearly all that was required to be done to the engines, and the satisfactory results of the official six hours' trial on Friday will compare very favourably with the original *data* on the mile, the more especially when it is stated that the superheaters with which the boilers were fitted have been removed. The new boilers, which were manufactured at Keyham, also possess less heating surface than the old ones. The trial on Friday was conducted on the part of the contractors by Mr. Gosling, Mr. J. Bannister representing the Admiralty, Mr. C. Icely the Steam Reserve, Mr. Newman, and Mr. Durstan the Factory Department, and Mr. Batt the Shipwright Department; Mr. John Penn was also present on the occasion. The ship was under the command of Captain Richard Wells, and Mr. Harding performed the pilotage duties. Altogether, the Sultan was under way eight hours between Spithead and the Nab, so that time did not permit of the first two half hours (during which the fires were foul with small coal, and steam was being raised to the *maximum* required) being thrown out. Had this been possible, the mean results of the six hours' full-power steaming without stopping would have exhibited still better figures, as the power was rising when the trial was brought to a close. The steam navigation coal was found so small that it was deemed advisable to mix it with north-country coal, and the stoking was not so uniform as could have been desired, the length of grate surface rendering it exceedingly trying to the men. The result was that the horse-power, which was 7,224·34 at the end of the first half-hour, reached a *maximum* of 8,531·12, and ended at the twelfth half-hour with 8,119·03. The means of the trial were:—Pressure of steam in boilers, 28·4lb., and in cylinders, 18·67lb.; vacuum in condensers, 26 inches; revolutions per minute, 69·45; and indicated horse-power, 7,736·11, being at the end of ten years 536 beyond the original guaranteed power. The mean of two runs on the measured mile showed a speed of 14·8 knots; but as the ship was a foot and a half lighter than when at her load-line, this result is of little practical importance from a service point of view. The engines were stopped in 13 seconds, started astern from dead stop in 8 seconds, and from going astern they were started ahead in 15 seconds. The amount of coal consumed during the trial amounted to 1,314 cwts., giving 3lb. for every unit of indicated horse-power. The engines gave no trouble from first to last, not a drop of water being necessary to keep the bearings cool during the long grind, while the boilers were entirely free from priming. The ship steamed into dock during the trial, and will be completed for the pendant.—*The Times.*

REVIEWS.

Shorthand: Rev. James Williams, Pontypridd. London: T. F. Shaw and Co., Newington, S.E.

From the many years experience of this author, as teacher of Pitman's system of Phonography, the students of Mr. James Williams' new system may rely upon studying, that which will most easily repay their attention. We are overwhelmed by learning the defects of our ordinary alphabet as pointed out by Mr. Williams, and wonder that the uninitiated are so content in the use of it. The basis of the system advocated in this manual of alethography is essentially simple. The consonants are divided into similar pairs of which one is light and the other heavy, and the distinction is easily shown by the pressure of the pen, giving a respectively light or heavy stroke. By the use of lines and curves, all the distinctive consonants can be formed, and vowels by the use of similar light or heavy but shorter strokes. Shorthand is necessarily a laborious and therefore far from enticing study but the system of Mr. James Williams seems one of the best we have seen.

Model Yacht Building and Sailing, by T. E. Biddle. London: Charles Wilson, 157, Leadenhall Street, E.C.

This is a book that we heartily regret not to have known in our younger days. Model yachts have always been an enticing study to the youth of this sea-girt isle, but for want of good instruction and guidance has often, resulted in disappointment to the enthusiastic but ignorant builder. In the book before us, every detail, or construction, and handling, is so clearly put before the readers that there can be no reasonable opportunity for the student to fail in obtaining what he may aspire to in a real serviceable model. There is a side however to this book that is in our mind especially commendable. Although the opening chapters are particularly designed to give the veriest tyro the clearest possible instructions there is a great deal that is instructive in the after chapters to yachtsmen of all ages. The youth is told the broad principles alone of mid-ship section being dependent on the displacement of the fore and aft sections, and also the importance of the vessel having approximately and equal displacement on either side of the centre transverse line. In the after chapters, however, stronger meat is given to those able to digest it, and the wave theory and hints on design, receive very able and clear handling. The attention of readers is drawn to a most important point, which we are glad to emphasize in our turn, to those who may read this notice, viz., the value of testing methods of construction in small models before applying them to sailing vessels or racing yachts. The results obtained in this way have been sufficiently proved by the success of Professor Froude's, researches in sections of minimum resistance.

There is much field yet open, we believe, to experiment and research in this direction, and we fully think that if our amateur yachtsmen were to take to model building we should hear more of successful experimental building, both for sea-worthiness and speed.

The New Transatlantic Cable.—The cable steamer *Faraday* left Millwall at an early hour on June 23rd, and during the forenoon was safely moored abreast of Messrs. Siemens' works at Charlton. The *Faraday* is a powerful steamer of 4900 tons, built at Newcastle in 1874 for Messrs. Siemens, and designed specially for laying cables. In the course of the afternoon she was surrounded by barges; those on the outside supplying her bunkers with coal, and those next to shore being employed in passing the cable into the steamer's tanks. The new company, the official style of which is "La Compagnie Française du Télégraphe de Paris à New York," has opened offices in London for the transaction of executive business at 100 and 101, Gresham House, Old Broad Street. The *Faraday*, having on board the shore end and the Brest-Scilly section of the new cable, was cleared at the London Custom-house on Tuesday night for New York, and sailed for Brest the following morning. Her departure had been delayed, the wet weather having interfered with the work of coiling the cable in the bunkers.

New Steering Apparatus.—Captain T. B. Heathorn has just taken out letters patent for a new arrangement of steering gear, which enables the rudder, or rather rudders, for two are employed, to serve for stopping as well as guiding the vessel. The arrangement it is not very easy to make intelligible without the aid of a drawing, but briefly it is as follows:—There are, as above stated, two rudders, one at each side of the stern, or in close proximity abaft the stern-post. Each rudder is worked by a horizontal slotted lever, in the slot of which there travels a stud, mounted on the end of the tiller. The pivot on which the tiller works is mounted on a nut, carried by a screw set in a direction fore and aft of the vessel. Upon the screw being turned, the nut is carried along, and the stud thereon acting in the slot of the levers, both the rudders are thrown outwards, in fact, the action of the ordinary steering gear, acting thorough the tillers, is to cause both rudders to move in the same direction and steer the ship, while the action of the screw is to cause the rudders to move in opposite directions, so that they are thrown out from the ship's side and tend to stop her. Captain Heathorn considers the action of the two rudders to be superior to the ordinary rudder from the effect they have on the column of water driven backwards by the screw. A similar arrangement may also be applied to a boat's rudder, but in this case it is worked by the yoke-lines instead of by a screw. Captain Heathorn also considers the mechanical arrangement of this apparatus applicable to many purposes, amongst others, that of loading heavy guns.

KUNSTADTER'S SCREW STEERING APPARATUS.

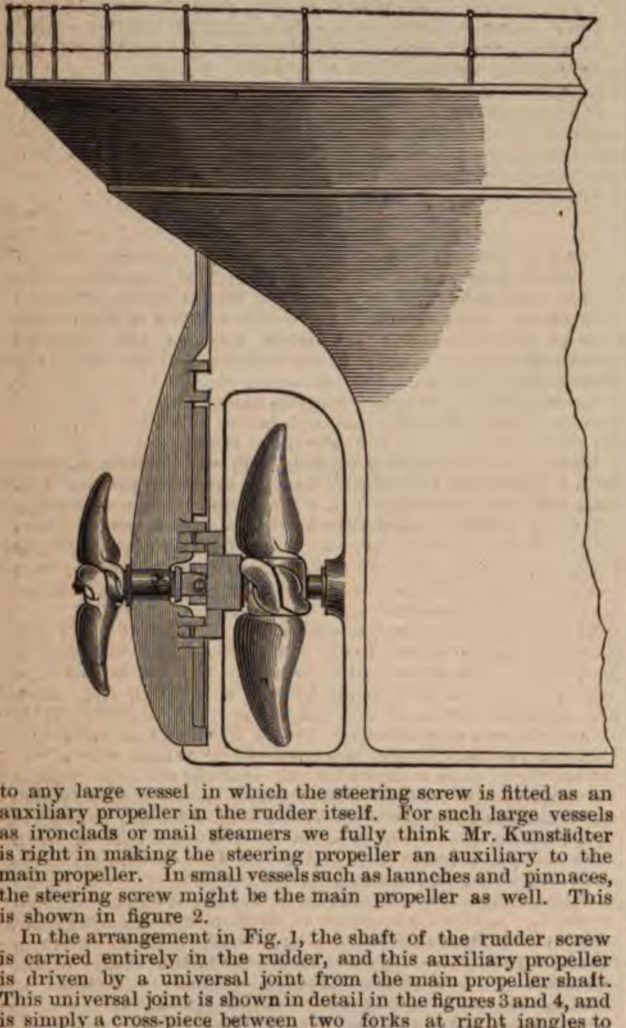
Attention has been very forcibly drawn of late to the necessity of having vessels under immediate control so that they should answer their helm at once, whether they have much way on them or not. It will easily be seen that the system of steering by rudder is defective in that respect, that at most it is only an angle of about 45° that can be described, of which a very considerable amount must be forward travel.

In some cases where a steamer is almost without way on her, entering a harbour for instance, she may be drifting rapidly on to a rock or bar by the influence of a current or tide. It would be then imperative in order to save her to be able to give her possibly immediate movement almost on her own centre in order to escape the threatening obstacle—only a screw-steering gear can really effect this.

Again from the point of view of maximum speed, the rudder acts as a resistance to speed, whilst a screw-steering gear is an additional incentive to speed.

We this month illustrate Mr. Kunstädter's screw-steering apparatus, which appears well suited to effect the purposes as above described. The apparatus is shown in figure 1, as adopted to any large vessel in which the steering screw is fitted as an auxiliary propeller in the rudder itself. For such large vessels as ironclads or mail steamers we fully think Mr. Kunstädter is right in making the steering propeller an auxiliary to the main propeller. In small vessels such as launches and pinnaces, the steering screw might be the main propeller as well. This is shown in figure 2.

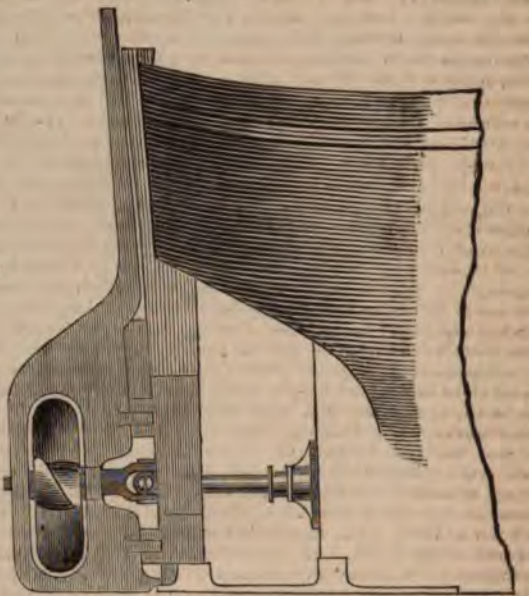
Fig. 1.



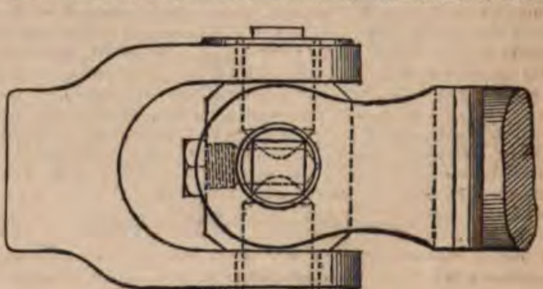
In the arrangement in Fig. 1, the shaft of the rudder screw is carried entirely in the rudder, and this auxiliary propeller is driven by a universal joint from the main propeller shaft. This universal joint is shown in detail in the figures 3 and 4, and is simply a cross-piece between two forks at right iangles to each other. This joint allows of perfect freedom of motion to the rudder and auxiliary steering screw all the while that it is being continuously driven from the main shaft.

Mr. Kunstädter claims the following advantages for his arrangement, 1st.—It will enable a vessel to turn within a very short distance and time instead of as at the present requiring 6 to 8 times her own length and 8 minutes or more (Vide report of trials of the Admiralty and Board of Trade). 2nd.—It will effect great saving in enabling large ships to be employed in river navigation, their use having been hitherto precluded by difficulty of steering. 3.—The rudder now in use acts by resistance. The patent rudder screw is actually a motive power in turning the hull, thus counteracting the influence of currents and effecting a great saving in obviating the necessity of employing steam tugs to assist in turning long vessels in a tide way, or guiding ships in and out of harbours and rivers. 4.—The rudder now in use fails as regards heavy ironclads, as seen in the "Grosser Kürfurst," thus making this screw a necessity for swift manœuvering of iron clads in action or whilst cruising. .5—It will prevent collisions, thus averting such lamentable catastrophes as the loss of the "Vanguard" and the "Princess Alice," or the stranding of such vessels as the "Iron Duke." 6.—It is specially well adapted to torpedo boats, the rapid handling of which is of the highest importance and which at present causes enormous difficulties. 7.—It enables a vessel to commence turning before she has acquired speed ahead, which is a point of vital importance, but which is not attained by the ordinary steering rudder as now in use. 8.—Great difficulties and danger is experienced in the passage of large vessels through the Suez Canal, the Danube, and many other narrow channels on account of defective steerage way, these difficulties however will not be experienced if this rudder-screw is used. 9.—The apparatus is simple, inexpensive and durable, not liable to get out of order, and is easily applied to vessels of all sizes, and can be fitted with facility to vessels already built or building: 10.—In small vessels the "Kunstadter Steering Screw" will be a sufficient propelling as well as steering power, but on large ships it will act as an auxiliary to the ordinary propeller.

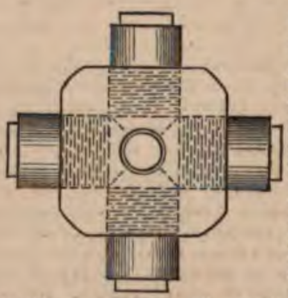
2



3



4



We have looked through a series of reports of trials and find that the claims of the inventor as above are very well borne out by the published results. We find results that going at full speed an experimental vessel turned in her own length in 68 seconds, another completed a circle in less her own length in 64 seconds. Iron barges seem also to have capital results on the Thames for handling with this rudder screw.

CORRESPONDENCE.

THE PAY OF MARINE ENGINEERS.

Sir,—It may not be generally known that an official statement of a proposed reduction of pay to seagoing engineers has recently emanated from the hand of the secretary of the North of England Shipowners' Association, and I believe has been acted upon some time ago. The rate of pay to the different grades of engineers has hitherto been— for steamers having engines of over 100-horse power nominal, training in the Mediterranean, Baltic, or across the Atlantic, chief engineer, £14 a month; second engineer, £9; third, £7; and if to India the pay was respectively £16, £11, and £8. In consideration now of the slackness of all trade, the above-mentioned secretary has proposed that the rate of pay on the Mediterranean, Baltic, and Atlantic shall be respectively £12, £8, and £6; and for India, £14, £10, £7; and nearly all the shipping companies whose steamers sail from the Tyne, Wear, Tees, and Humber have consented to this reduction, and are now acting upon the proposition. In addition to this, it has been further proposed, and is also being acted upon, that the use of an engineer's steward shall be dispensed with altogether. It seems to me, Sir, that in accepting this proposal, owners are neglectful of their own first interests, for no man with a moment's consideration will refuse to admit that a careless or discontented engineer can do his master damage to the extent of many pounds every day he serves on board, and this reduction of hitherto poor pay, will of necessity drive good men away from sea-going as a profession and advance the host of incompetent men who serve now in the capacity of third engineers. There is, I think, hardly any branch of engineering so backward as the marine branch, and the reason is not far to seek. Sea-going engineers are too easily to be had, and the pay of beginners is too good, What I mean is this—a young apprentice just out of his time comes to sea, and gets, no matter what his capabilities may be, pay at the rate of £7 a month, and so as boys can thus earn nearly twice the money at sea which first-clas mechanics earn in the workshops, they rush there and imagine that they are worth the money thus paid to them. Some of these men may be very good engineers, and as surely as they are, so surely do they get on and attain to higher positions, but the increase in their pay is not at all in proportion to this. Engineers holding grade now as first or second-class are obliged to prove their capacity before the Board of Trade examiners, who are getting, and justifiably so, more exacting every day in their examinations, they are compelled to give up home with all its blessings and happiness; they are forced to put up with hardships which only sea-going men know anything o', and which only engineers have to put up with. Drenched in the filthy bilges; roasted if tubes give way—and a gentleman at this moment sits at the other side of the table on board our ship as I write, who has been no less than thirteen times in the combustion chamber of a boiler on one voyage from the Tyne to Malta, she having burst no less than thirteen tubes in that time, suffocated when battened down in bad weather, and a hundred other hardships unknown to the sailors on deck, and for all this they are now to be paid at the princely rate of £12 and £8 a month. The proposed reduction will reduce the expenses of a ship nominally by £4 a month for engineers and £2 by the saving in withdrawing their steward, that is £6 altogether. Now, if this saving is to make a ship pay, the sooner she is laid up and put out of commission the better, There is nothing which tends more to the economy of a ship than the possession of a good engineer, and as good engineers were rare at £14 a month, where will they be when £12 is offered? As to the withdrawal of the engineers' steward, I cannot at all fathom this. Are they to live in perfect neglect of their rooms, or how is it to be managed? The only harm I wish the author of this official document sent to the various shipowners is that he should be sent across the Atlantic for a winter run; that he should be attached to the engine-room department; and that he should be obliged to take a "spell" at baling the water out of his berth and the mess-room, as it has been my pleasure to do. Had he this experience I incline to believe he would rather advocate the addition of a second engineers' steward than the withdrawal of their only one. This infringement on the comfort of the engineers is a most unwise and most unfair one, and one which certainly ought not to be allowed to be made unprotested against. Speaking of the accommodation of engineers at sea, the author of "The Engine-room, and Who Should Be In It," a gentleman of very large sea-going experience, and one who now ranks amongst the foremost of our marine engineers, says "Bad accommodation is the principal reason why intelligent practical engineers won't go to sea; make an engineer comfortable and he will give no bother, the engines and boilers will be better attended to, and the owners interest will be cared for. Why should the captain or mate have better accommodation than the engineer? This I could never learn. I consider the captain and engineer of a vessel the only two men the owner has in the ship—the captain to guide from port to port, the engineer to keep his machinery in order and to save coals. What a saving a fairly paid and comfortably berthed engineer can effect; what a *loss* an indifferent and dissatisfied one produce? Shipowners should bear this in mind." Whilst so much, Sir, is being said on the subject of sea-going engineers, would it not be well if the Board of Trade were to take the subject of third engineers in hand and endeavour to make something of it? At the present time hundreds of young men are being sent to sea who have no more notion even of the first principles of a marine engine than the man in the moon; the reason of their being so sent is that, perhaps they are to proud to serve in the shops, and feeling that their dignity as "engineers" at sea would be much more imposing than as merely "fitters" if they stayed in the shops. Again, for the attainments—at least, of such thirds as I have have had the pleasure (?) of serving with—their pay if far too high. Now, if the Board of Trade would only institute an easy examination for thirds which would prove their knowledge of something about engines; let them at least prove that they know the difference between a piston and a propeller; or if that same mighty body would only introduce a law or rule that no one should be allowed to serve as third engineer until he had previously been six months at sea, as store-keeper, greaser, &c., we should not have so many rushing for births, the recruits would be infinitely better men, and so we should improve intellectually the whole genus of sea-going engineers.

By the way, in the secretary's—of the Shipowners' Association—paper I do not see any mention made of the reduction of the home-going engineer's pay. They who are not required to have any certificates, and who are at their homes once a week at least, are to be left in undisturbed possession of their pay, and we foreign-going-fellows, who are very rigidly compelled to have certificates, and who are oftentimes many months away, we are to be the men to suffer; and all the time we have little to do with the welfare of England, for our work is mainly in trading between foreign countries—from Belgium to South America, North America to France, Russia to Holland or Belgium, America to Denmark, Russia to Holland or Belgium—indeed all the time I have been at sea, I have never discharged a cargo in the three kingdoms.

Rotterdam, June 16th. A Foreign-going Engineer.

LAUNCHES AND TRIAL TRIPS.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of The Marine Engineer as complete and reliable as possible, and will thankfully receive all such information or accounts of any novelties relating to any branch of the marine engineering trades. *To ensure insertion, all such favours should be in our hands by the 26th, of the month.* —Ed.]

LAUNCHES.

ENGLISH.

Clymene.—On the 5th June Messrs. M. Pearse and Co., launched from their iron shipbuilding yard at Stockton an iron screw steamer of the following dimensions:—Length between perpendiculars, 245 feet; extreme breadth, 33 feet; depth of hold to top of floors, 22 feet. She has a gross measurement of about 1,500 tons, and a carrying capacity of about 2,200 tons deadweight. This vessel is built off the three-decked rule, the main and upper decks being of iron, is classed 100 A 1 at Lloyd's, and has been built under special survey. The fore and after holds are arranged for water ballast. She is provided with three very powerful double cylinder steam winches, and all the most recent and improved appliances for loading and discharging cargoes expeditiously. She will be rigged as a two-masted schooner, with double topsails on the foremasts. The engines, which are of 140-h.p., are from the well-known works of Messrs. Blair and Co., of Stockton. As the vessel left the ways she received the name of Clymene, the ceremony being performed by Miss Florence J. Blair, daughter of G. G. Blair, Esq., J.P., the head of the engineering firm which supplies the machinery for the vessel. The steamer is intended for the Black Sea and Atlantic trades, and will be commanded by Captain E. Hall.

Cora Maria.—On the 5th June a screw steamer, of about 1,700 tons burthen, was launched by Messrs. Schlesinger, Davis, and Co., of Wallsend. The vessel, which is of the following dimensions—length between perpendiculars, 235 feet; breadth moulded 31 feet, depth moulded, 19 feet 7 inches, and classes 100 A 1 at Lloyd's under special survey — has been built to the order of Messrs. Capper, Alexander, and Co., of Cardiff. The Cora Maria is constructed with a long half poop bridge amidships and topgallant forecastle, double bottom for water ballast, iron decks, and all other modern requirements. Her engines are of 110-horse-power, compound surface-condensers, made by Messrs. Thos. Clark and Co., of Newcastle. Captain Dunn will command the vessel. As the Cora Maria left the ways she was christened by Miss Turnbull.

Earl of Jersey.—On the 7th of June Palmer's Company. Jarrow, launched a new steamer, built to the order of Messrs. Martin and Marquande, Cardiff. The vessel is intended for the Bilbao iron ore trade, and was named the Earl of Jersey. Her dimensions are:—Length, 210 feet; breadth, 30 feet; depth of hold, 15 feet; gross tonnage, 1,150 tons.

Steamtug.—On the 14th June a new tug steamer intended for the Bristol Channel was launched at the works of Messrs. Elliott and Jeffreys, engineers, West Docks, Cardiff. The steamer is the second iron tug launched at Cardiff, and was built by her Owners for the Cardiff trade. She is 93 feet long, with a breadth of 17 feet 6 inches and is fitted with two engines of 40 horse-power.

Saloon Steamer.—On the 16th June the paddle-wheel saloon steamer for the Sproston Dock and Foundry Company, Demerara, was launched from the yard of Messrs. R. and H. Green, of Blackwall. Here extreme length is 180 feet 3 inches, and extreme breadth 35 feet 10 inches. She is to be fitted by Messrs. John Penn and Sons, of Greenwich, with direct-acting compound engines. This is the ninth steamer built in England belonging to the firm, four of which have been built by Messrs. R. and H. Green.

Adirondack.—On the 18th June a large screw steamer, named the Adirondack, which has been built for a Liverpool firm, was launched from the shipbuilding-yard of Messrs. C. Mitchell and Co., Low Walker. The following are the dimensions of the vessel:—Length over all, 292 feet; beam 35 feet; depth in hold, 24 feet 6 inches. The steamer has been built for the Atlantic trade to the highest class at Lloyd's, and has extra strengthening beyond their requirements. The carrying capacity of the vessel will amount to nearly 3,000 tons deadweight. Directly after the launch she was towed to the works of the Wallsend slipway and Engineering Company, where she will be fitted with engines of 200-horse-power.

Halo.—On the the 19th of June Messrs. Edward Withy and Co., launched from Middleton Shipyard, Hartlepool, an iron screw-steamer, which has been built to the order of Alderman George Horsley, J.P., of Hartlepool. This vessel is No. 81 in the Builder's yard, is the fourth built for the same Owner, and the ninth sister ship from the same model. Her principal dimensions are 243 feet 9 inches by 32 feet by 18 feet 6 inches and 22 feet 6 inches. She has been built under Lloyd's special survey for the 100 A 1 class; has long quarterdeck, iron Liverpool house aft. long, bridge, and top gallant forecastle; she has double bottom for water ballast in both holds, and in engine and boiler room; three steam winches, patent windlass, iron decks; is constructed throughout in a specially superior manner, and will be rigged as a topsail schooner. She will receive engines of 120 h.p. by Messrs. T. Richardson and Sons, of Hartlepool Ironworks. The steamer was christened Halo by Mrs. Erichsen, of West Hartlepool.

Navigation.—On the 19th June there was launched from the shipbuilding-yard of the Palmer Iron Shipbuilding and Iron Company (Limited), Jarrow, an Iron screw-steamer, named the Navigation, and built for Messrs. Dixon and Harris, of London. The steamer is of the following dimensions:—Length, 247 feet; breadth, 34 feet; depth, 21 feet. She is intended for the general trade, and her carrying capacity is 2,200 tons deadweight. She will be fitted with water ballast compartments, and her main deck and the poop, forecastle and bridge decks are formed of iron sheathed with wood. The Navigation will be supplied with a pair of Messrs. Palmers' direct-acting compound surface-condensing engines of 150-horse-power nominal. The ceremony of naming the steamer was performed by Mrs. Finlay of London.

Norfolk.—On the 21st June, a steamer of 3,000 tons was launched from the yard of Messrs. H. and R. Green, at Blackwall. The ship has been built by Messrs. Green for their former neighbours and rivals in the Shipping Trade, Messrs. Money Wigram and Sons, who still carry on service of passenger ships between this country and the Australian colonies. The dimensions of the new vessel are 320 feet between perpendiculars, 40 feet breadth of beam, 25 feet 6 inches in depth in hold to maindeck, and she will register nearly 3,000 tons. Her engines, which are to be fitted by Messrs. Humphreys and Tennant, of Deptford, are of 3,000 indicated horse-power. The Norfolk is fitted with berths for 90 first-class passengers, 90 second-class, and 150 third-class. The vessel was named by the Hon. Mrs. R: Bevan.

Arranmore.—On the 24th May, Messrs. Wm. Doxford and Sons launched from their building-yard at Pallion, Sunderland, a screw steamer, named the Arranmore, of the following dimensions:—Length, 255 feet; and breadth 33 feet; depth, 18 feet. This steamer is built for Messrs. Wm. Johnston and Co., Liverpool, is fitted with all the latest improvements for working cargo, &c., and is of the highest class.

Chilton.—On May 24 Messrs. William Gray and Co., of West Hartlepool, launched an iron screw steamer, built to the order of Messrs. T. Appleby and Co., of that town. Her dimensions are:—Length, 228 feet; breadth, 30 feet; and depth of hold, 16 feet 9 inches and 20 feet 9 inches; and her gross tonnage is 1,100 tons; she will carry 1,400 tons on a light draught; and classed 100 A 1, the highest class at Lloyd's; schooner-rigged. She is fitted with complete double bottom for water ballast, raised quarterdeck, long bridge, and topgallant forecastle for Crew; steam winches and steam windlass, and all the latest improvements for the rapid loading and discharging of cargo. She will be commanded by Captain J. J. Baker, of West Hartlepool. As she left the ways she was named the Chilton by Mrs. Gourley, of West Hartlepool.

Meath.—On May 24, a screw steamer for Mr. R. M. Hudson and Partners, Sunderland, was launched from Palmer's Shipbuilding and Iron Company's Yard, Jarrow. The dimensions of the vessel are:—Length, 290 feet; breadth, 35 feet; depth, 24½ feet; carrying capacity about 3,000 tons. As the vessel is intended for the general carrying trade she has been built extra strong, and will be classed 100 A 1 at Lloyd's. She will be fitted with Palmer's engines of 170-horse power nominal. The upper and main decks will be of iron, and the steamer will be fitted with water ballast, and all other modern improvements. As she glided into the river she was named the Meath.

Paxo.—On June 3 there was launched from the shipbuilding yard of Mr. James Laing, Deptford, Sunderland, a screw steamer of about 2,500 tons burthen, built to the order of Messrs. D. G. Pinkney and Son. Her dimensions are as follows;—270 feet length; 34 feet 6 inches breadth; 20 feet 6 inches depth of hold; 7 feet awning deck: and she is intended principally for the Indian, American, and Black Sea waters. She is fitted with all the latest appliances, and will be fitted with engines of 160-horse power by Mr. George Clark, Southwick. There is an awning deck the whole length of the vessel. She is specially suitable for carrying large cargoes of light goods and dead weight. The ceremony of christening was entrusted to Mrs. Kekerman, the wife of Alderman Kekerman, of Huddersfield, and as the vessel left the stocks she was named the Paxo in the usual way.

Mildred.—On the 5th of June, Messrs. T. Turnbull and Son launched from the Whitehall Shipyard, Whitby, a screw steamer of the following dimensions:—Length, 238 feet 6 inches; breadth 33 feet; depth, 18 feet 6 inches; deadweight capacity, 1,900 tons. The vessel is built to class 100 A 1 at Lloyd's, and will be fitted with engines of 120 horse-power, by Blair and Co.. Stockton-on-Tees. She has been built for the Mediterranean and Black Sea trades, and is the 21st vessel at present owned by the firm of Messrs. Turnbull and Co. On leaving the ways she was named the Mildred by Miss Mildred Turnbull.

Lartington.—On June 21 Messrs. Short Brothers, Pallion, Sunderland, launched from their shipbuilding-yard a screw steamer, to the order of a local firm. of the following dimensions:—Length 260 feet; breadth, 36 feet; and 19 feet depth of hold; classed 20 years Red, Liverpool Registry, The vessel is constructed with a short full poop, raised quarter-deck between poop and bridge-house, the latter extending over engines and boilers, and top-gallant forecastle, water ballast, all fore and aft, including engine and boiler space, four steam winches and donkey boiler by J. F. and W. Wilson, Monkwearmouth; Harfield's steam windlass, steel towlines, and all the latest improvements. She is to be fitted with compound engines of 160-horse power, by John Dickinson, Monkwearmouth. On leaving the ways, the vessel was named the Lartington by the daughter of the Managing Owner.

Foscolia.—On June 21 an iron steamship was launched from the yard of Messrs. Charles Mitchell and Co.. Low Walker. The vessel, which is built to the order of Messrs. Watts, Milburn, and Co., London, is intended for the general trade, but has also been specially fitted for the Danube grain trade. She is classed 100 A 1 at Lloyd's, and in many essential points the strengths are much in excess of Lloyd's requirements. The machinery is constructed by the Wallsend Slipway and Engineering Company. Miss Nichol, of Jesmond, named the vessel Foscolia, in compliment to one of its principal Owners, Mr. Foscolia.

Seeker.—On the 19th June there was launched from Mr. John Stephen's shipbuilding-yard, Devoran, a schooner, of the following dimensions;—Length of keel, 75 feet; beam, 19 feet; depth of hold, 9 feet 3 inches. She will be classed A 1 at

English Lloyd's for nine years. As she left the ways she was named the Seeker by Miss Ellen Stephens, daughter of the builder and Owner. She is intended for either foreign or coasting trade, and will be commanded by Captain Brokenshire, of Truro.

HIGHBURY.—On the 5th June an iron screw steamer was launched from the building-yard of the Tyne Iron Shipbuilding Company (Limited), of the following dimensions, viz :—Length 278 feet; breadth, 35 feet; depth of hold, 24 feet 6 inches. This vessel has been built under special survey for the 100 A 1 class London Lloyd's, and is fitted up for the Indian and Atlantic trades. She has patent windlass, Donkin and Nichol's patent steam steering gear, and all modern improvements suitable for her efficient working. She was named the Highbury, by Miss Christina Nichol, of Jesmond, on leaving the ways. The engines for the Highbury are to be supplied by Messrs. R. and W. Hawthorn, and are of the following dimensions, viz:—cylinders 32 and 62 by 42 stroke. Pressure of steam in boilers, 80 lbs.: They have been built under Lloyd's survey throughout. The Highbury is the property of the London house of Messrs. Watts, Milburn, and Co.

ROBERT BROWN.—On the 5th June there was launched from the iron shipbuilding-yard of Messrs. John Readhead and Co., the Lawe, South Shields, a screw steamer, which has been built to the order of Mr. W. D. C. Balls, of Tynemouth, and partners. The vessel was named the Robert Brown, and the following are the dimensions of the ship;—Length, 235 feet 9 inches, breadth, 33 feet; depth of hold, 19 feet. The vessel is fitted with all the most modern improvements for rapid discharging of cargo, &c., she has a raised quarter deck and topgallant forecastle, and an iron house aft, protected by an iron rounded stern, She is also provided with Harfield's patent windlass, steam winches, water ballast, shifting boards for grain cargoes, and all the details of general cargo boat. She is classed 100 A 1 at Lloyd's, is 1,350 tons gross register, and will carry 1,850 tons dead weight. The steamer will be fitted with compound surface-condensing engines of 120-horse power nominal, by Messrs. Readhead and Co. The Robert Brown will be commanded by Captain Gray, of South Shields, and will be employed in the Mediterranean and American trades. As she left the ways the ceremony of naming her was performed by Mrs. Quin, of Tynemouth. This is the second steamer built by Messrs. Readhead and Co., for the same Owners.

On the 5th of June an iron sailing barque was launched from the shipbuilding yard of Mr. R. Thompson, jun., Southwick, of the following dimensions:—Length, 233 feet; breadth, 35 feet; depth of hold, 21 feet 4 inches, She is about 1,208 tons gross register, and has been built under special survey for Lloyd's 1 A class. She has a full poop aft, with cabin fitted up in first class style, topgallant forecastle for accommodation of Crew, and large iron house amidships fitted with galley, condensed workshop, &c., and accommodation for petty Officers and boys. She is fitted with Hayfield's patent manual capstan windlass, the patent Reliance pumps by Henry Wilson and Co., of Liverpool, and all the most recent improvements The vessel has been built to the order of Mr. John Wilson, of London, and is the fourth built by the firm for the same Owner.

MADRID.—On the 5th June there was launched from Messrs. Wigham Richardson and Co., Neptune Works, Newcastle, an iron-screw steamer, 285 feet by 35 feet by 24½ feet, and of 200 horse-power. As the vessel left her berth she was named the Madrid by Miss Wailes of Tynemouth. The Madrid has been built to the order of Messrs. Hy. Buckwall and Sons, of London, and is specially designed as a large carrier for the Atlantic and Indian trades, and when completed will be classed 100 A 1 in Lloyd's Register.

WOODHORN.—On the 5th June, at the yard of Messrs. C. S. Swan and Co's., Shipbuilders, Low Walker, there was launched a screw steamer, built to the order of Mr. G. R. Dawson, of Blyth and partners. The length of the vessel between perpendiculars is 245 feet; breadth 33 feet, depth of hold, 23 feet. She will be classed 100 A 1 at Lloyd's. The cylinder of engines will be 30 and 57 inches diameter, about 39 inches stroke, and 130 horse-power, sufficient to give the steamer a leading speed of from 6 to 10 knots. The latter will be supplied by Clark and Co., Elswick. The estimated cost with first-class specifications and outfit being 22,000*l*. As the vessel glided into the Tyne it was named the Woodhorn by Mrs. G. R. Dawson.

ROSALIND.—On the 21st June the Tyne Iron Shipbuilding Company (Limited) launched from their yard, at Willington Quay, an iron steamship of the following dimensions, viz.;—Length, 220 feet; breadth 30 feet 9 inches; depth of hold, 15 feet. The vessel has been built to the order of Messrs. C. F. Jackson and Co., of Newcastle. She has a long raised quarterdeck to midships and a topgallantforecastle for the accommodation of the Crew. Her engines are to be supplied by Messrs. B. and W. Hawthorn, of Newcastle, and are of the following dimensions, viz.:—Cylinders, 28 and 54 by 36 stroke; pressure of steam 89 lbs.:—The vessel has water ballast right through the vessel, and has been built under special survey of Lloyd's for the 100 A1 class- Both ship and engine have been built under the inspection of Mr. H. Parry, of Newcastle, consulting engineer. As the vessel was leaving the ways she was named the Rosalind, by Miss Fenwick, daughter of one of the Owners.

SCOTCH.

VASCO DE GAMA.—On the 24th May a screw steamer named Vasco de Gama, was launched from the Shipbuilding yard of Mr. W. B. Thompson, Dundee. The vessel has been built to the order of Messrs. Robert M'Andrew and Company, Shipowners, London, and is to be engaged in the Mediterranean fruit trade. She is 1,600 tons gross register, and her dimensions are—Length, about 265 feet; breadth, 33 feet; and depth of hold, 24 feet. Her engines, which are compound surface-condensing, are of 250 horse power. The vessel has been fitted with water ballast; and machinery with all the modern improvements has been placed on board for taking in and discharging cargo. Accommodation has been provided for 20 passengers, and provision has also been made for the Captain, Officers, and Seamen. The Vasco de Gama is to be commanded by Captain John Forbes, lately of the Georgian.

LAKE WINNIPEG.—On May 26, Messrs. James and George Thompson launched from their yard at Clydebank a screw steamship of 3,200 tons and 500 horse-power for the Canada Shipping Company, which are represented in Glasgow by Messrs. P. Rintoul, Son & Co. The name of the Lake Winnipeg was conferred by Miss Rintoul, of Bothwell Bank. This vessel is the third steamer built for the Canada Shipping Company in Glasgow, their fleet otherwise comprising the well-known "Lake" Line of sailing ships. The Lake Winnipeg is specially built for the Canadian produce and cattle trade.

ALVO.—On the 26th May, Messrs. Aitken and Mansel launched from their yard at Whiteinch a screw vessel of about 2,000 tons gross register, which has been built for the Atlas Steamship Company of Liverpool; to the order of Messrs. Leach, Harrison, and Forwood, the Managing Owners. This vessel, which received the name of Alvo from Mrs. George Thornton, Patrick, will be placed by the Atlas Company on their mail service between New York and the West Indies, and will be fitted with accommodation for 60 first-class passengers, and every modern improvement for carrying purposes. The machinery will be supplied by Messrs. John and James Thomson, Finnieston Foundry, Glasgow.

OXTON.—On the 9th inst., a screw steamer, built and engined by W. Simons & Co., was launched complete from the London Works, Renfrew. This steamer is named Oxton, and is the property of the Corporation of Birkenhead. Its dimensions are 130 feet by 40 feet by 14 feet, and is fitted with two sets of independent compound engines of 500-horse power collectively. The Oxton is intended for the carriage, waggon, and goods traffic across the Mersey, and is classed 100 A 1 at Lloyd's.

PUCHOCO.—On the 18th of June a steamer, named the Puchoco, built to the order of the Pacific Steam Navigation Company, Liverpool, was launched from the yard of Messrs. Gourlay Brothers and Co., Dundee. This vessel is sister ship to the Arauco, built by the same firm two months ago, and, like her, is to be employed in the Company's coal trade on the West Coast of South America. The Puchoco is registered at of 850 tons gross, has been classed 100 A at Lloyd's, and will be supplied with compound surface-condensing engines of 110-horse power. She has been fitted with all the most improved appliances, including self-trimming hatches.

EMERALD.—On the 29th May, Messrs. Dobson and Charles launched from their building-yard an iron screw-steamer of 550 tons burthen, and the following dimensions:—160 feet by 24½ by 12½. She will be fitted with compound surface-condensing engines of 62-horse power, by Messrs. Dunsmuir and Jackson, Glasgow. and all the latest improvements. This steamer has been built to the order of Mr. James Hay, Glasgow. As she left the way she was named Emerald.

ESMERALDA.—On June 3 Messrs. Dobson and Charles launched from their building-yard at Grangemouth an Iron Screw steamer of 550 tons burthen, and the following dimensions;—

160 feet by 24½ by 12½. She will be fitted with compound surface-condensing engines of 62-horse power, by Messrs. Dunsmuir and Jackson, Glasgow, and all the latest improvements. This steamer has been built to the order of Mr. James Hay Glasgow. As she left the ways she was named the Emerald by Miss Hay, daughter of the owner.

Hilda.—On June 4th there was launched from the building yard of Mr. W. Pickard,of Appledore, a three masted brigantine of the following dimensions, viz., length 116 feet, breadth 24 feet 9 inches, depth 12 feet 9 inches, 230 tons register. She is named the Hilda, is the property of J. Pring, Esq., of Brixham, and is intended for the West India trade, under the command of Captain Oldreive.

Orient.—On the 5th June Messrs. J. Elder and Co., launched from their shipbuilding-yard at Fairfield one of the largest steamers ever built on the Clyde, and certainly the greatest acquisition to the Orient Steam Navigation Company, trading between London and Australia. The ceremony of naming the vessel was performed by Lady Gertrude Boyle, daughter of the Earl of Glasgow. The ship bears the name of the company for whom she has been constructed, viz.,, the Orient Steam Navigation Company (Limited), is intended to augment the fleet trading between this country and Australia, and will be commanded by Captain Hewison, the company's Commodore. The Orient will make the seventh large steamer at the service of the line, the names of the other six being the Lusitania, Cuzco, Chimborazo, Garonne, Aconcagua, and John Elder. Her dimensions are:—Length, 460 feet; breadth, 46 feet 6 inches; depth, 37 feet 8 inches; displacement at load draught, 9,500. Her engines, presently being finished by Messrs. Elder, are of the three cylinder compound surface condensing class, the high pressed being 60 inches diameter, and the two low pressed 85 inches, having a 5 feet stroke. They are fitted with Messrs. Brown Brothers' hydraulic and steam starting and reversing appliances, and Gwynne's patent centrifugal pumps. The indicated horse power of the engines will be 5,400, and the nominal 1,000. The ship will be fitted with four masts and two large funnels. Arrangements are made forward of engines and boilers for 120 saloon, aft of engines 130 second class, and 300 third-class or steerage passengers. Bath-rooms are fitted up all over the vessel for the comfort and convenience of all classes of passengers. For the special use of saloon passengers, a promenade deck 160 feet long by 43 feet wide is built above the music saloon, side houses, &c. The second saloon, which is aft, is 60 feet by 24 feet. On each side and aft are the staterooms. On the upper deck aft is a large apartment fitted up for the steerage single women, with wash-house, lavatory, &c., and the single men are arranged for right aft on the main deck while on the lower a large space is apportioned for married persons, and each of the above passengers have their own washing-rooms, fitted with baths, drying-rooms, &c. Chaplin's condensers, to produce 150 gallons of water per hour, together with cooling tanks, are also fitted up throughout the ship, there being a supply of fresh as well as salt water. She carries eight boats of the largest dimensions, and it is intended to fit out four of these with life-rafts, the whole being equal to a dozen of the largest class of lifeboats. The steam windlass is Messrs. Brown and Harfield's patent, and, in connection with the same, is a wrought-iron capstan. Messrs. Muir and Caldwell supply the steam steering gear. in the shape of their improved patent silent engine, and five powerful steam winches have also been fitted on board by the same firm. Messrs. Napier Brothers' powerful hand-steering gear, on the latest principle, has been added. Messrs. Broadfoot and Sons are the makers of the ship's pumps, the 9-inch one being of the Admiralty Downton type, and the 7-inch is Broadfoot's direct-acting treble-suction pump, which has enormous, lifting powers. In addition to the pumps on the main engine, there are two steam fire and 5 deck, besides several ordinary lifting ones, and large suction pipes are also fitted to all parts of the vessel from the main engines. The ventilation has been a special study, Messrs. Mosses and Mitchell's patent automatic ventilators having been adopted. The lower deck, which has been so arranged that a passage can be made fore and aft as far as the ship's collision bulkheads, will, when required, accommodate 1,500 troops, and the orlop deck alone could be so arranged as to carry from 300 to 400 horses. The ice house store-rooms are also very large, and built of iron. To ensure safety she is divided below the main deck into 13 water-tight compartments by the bulkheads these being fitted at the lower deck with malleable iron watertight doors, which are worked from the main deck, while from the latter deck to the main she is divided into 6 compartments by fire-proof bulkheads, each fitted with fire-proof doors. The Orient will carry four masts, with a good spread of sail, alone sufficient to give her good speed. Built under Lloyd's special survey for the 100 A class, the steamer has three iron decks, and is far beyond the usual requirements In fact, every improvement shipbuilding and marine engineering could suggest has been adopted.

Rotomahana,—On the 6th June there was launched from the building-yard of Messrs. Wm. Denny and Bros., Dumbarton, a screw steamship of about 1,800 tons gross measurement, for the Union Steamship Company of New Zealand, Limited. This vessel has been built entirely of steel, to class A 100 at Lloyd's under special survey. She will have compound direct-acting engines of 500-horse-power nominal. She will be fitted up for a large number of first and second-class passengers, special attention being given to the ventilation of the state-rooms on a new principle, and safety of passengers. The vessel on leaving the ways was named the Rotomahana by Miss Janet Leslie Denny, daughter of the senior partner of the firm of builders.

Jessie.—On the 6th June there was launched from the yard of Messrs. W. Pickersgill and Sons, Southwick, Sunderland, a barquentine of the following dimensions, viz.:—Length 125 feet; breadth 25 feet; depth 12 feet 9 inches; 250 tons nett register. She has been built to the order of Messrs. J. and J. Denholm, Greenock, and specially surveyed to class 12 years A 1. She is intended for the Brazil and West Indian Trades, and will be commanded by Captain Wm. P. Putt, On leaving the way she was named the Jessie by a daughter of the builders.

Otto M'Combie.—On the 7th June a steamer named the Otto M'Combie, built for Messrs. James M'Combie and Co., fish curers, Peterhead, was launched from the Caledon Shipyard, Dundee (Mr. W. B. Thompson's). The vessel is 350 tons gross, 165 feet long, 23 feet broad; the depth of her hold is 13 feet, and she has been classed 100 A 1 at Lloyd's. As the vessel is to be engaged principally in the herring trade between the north of Scotland and the Continent, she has been specially strengthened to adapt her for tidal harbours. She is schooner-rigged, fitted with water ballast, and has been supplied with Thompson's patent windlass and steering gear and all other improved appliances. The Otto M'Combie, which is to be commanded by Captain Bannerman, will be fitted with compound surface-condensing engines of 60-horse power.

Romulus.—On the 7th June Messrs. H. M'Intyre and Co., launched from their shipbuilding yard, at Merksworth, Paisley, an iron screw steamer of 1,200 tons, and classed 100 A 1 at Lloyds. The vessel, which has a large poop aft, and has accommodation for first-class passengers, is fitted with every modern improvement in hull and machinery. As she left the ways she was named the Romulus by Miss White, Dumbarton. She will be engined at Glasgow by Messrs. Hutson and Corbett.

Walkyrie.—On the 9th June Messrs. John Reid and Co., launched a steam yacht, the dimensions of which are:—Length, 108 feet; breadth, 15 feet; tonnage, 84 register. She has been built for Mr. Thomas Barclay, Edinburgh, and is named Walkyrie. The engines are by Messrs. Rankin and Blackmore, Greenock. and are on the compound direct-acting principle. The cylinders are 21·5 inches and 10·6 inches in diameter respectively, with a piston stroke of 16 inches. She is to be commanded by Captain Knight.

TRIAL TRIPS.

The Late Cunard Liner Scotia.—Few would recognise in the large twin screw steamer which left the Mersey on Thursday last the once famous Cunard Liner Scotia, the last of the great paddle steamers built for the Atlantic trade, and which, under the command of the late Captain Judkins, was for years looked upon as the fastest and favourite vessel on the line between Liverpool and New York. The Scotia was built in 1862 when with the exception of the Great Eastern, she was probably the largest mail steamer afloat, being about 400 feet long over all, 47 feet 8 inches beam, and 4,050 tons builder's measurement, and fitted with a pair of side-lever engines of 1,000-horse power. The introduction of screw steamers fitted with compound engines for the Atlantic and other ocean voyages has of late years entirely superseded the paddle steamers, and a few years back the Scotia was withdrawn from the Cunard Company's sailing list, and was subsequently purchased by the Telegraph Construction and Maintenance Company to be employed in their cable-laying operations. To fit her for this work very extensive alterations were of course necessary, the execution of which the company entrusted to Messrs. Laird Brothers, and during her stay at the Birkenhead Iron Works the Scotia had been stripped of her masts, funnels, machinery, paddle-wheels and paddle-boxes, deckhouses, &c.; she has also been raised by the addition of a spar deck, and altered about the after end to prepare her for twin screws, and has been fitted with new compound engines and also provided with three immense cylindrical tanks in which to stow the electric cable, as well as with most elaborate and approved steam machinery for paying out and hauling in; also steam capstan, steam steering gear, winches, &c. The new engines are two distinct sets, on the compound system, with inverted cylinders 38 inches and 66 inches diameter, and 3 feet 9 inches stroke, supplied with steam at 75 lbs pressure from three double-ended cylindrical boilers, and are calculated to drive the vessel at a speed of about 11½ knots an hour. The Scotia sailed for London on the 22d May under the command of Captain Cato. The new engines worked beautifully during the run, and everything in connection with the vessel gave the greatest satisfaction.

The Arizona.—The Arizona, built and engined by Messrs. John Elder and Co., went on her builders' trial trip on the 23rd May. The steamer is 464 feet long, 46 feet in breadth, and 37 feet 6 inches deep, with a gross tonnage of 5,400, and 3,470 register. In her construction many new and improved appliances have been introduced. She has no fewer than five cargo hatches to which are attached patent steam winches, the total cargo space being 167,000 cubic feet, and her dead-weight cargo, exclusive of 1,200 tons of coal, will reach 2,600 tons. She is fitted with four masts, the first and second square-rigged. Besides her great carrying capacity for goods and general cargo, the passenger accommodation has by no means been overlooked as there are ample room for 140 first, 140 second, and 1,200 third-class, or emigrants. The ship's water condenser and fresh water tanks are the largest ever fitted into any vessel, condensing at the rate of two gallons per minute, or about 3,400 gallons per day. These, together with cooking range, &c., have been supplied by Messrs. A. Brownlie and Co., Glasgow. She is fitted by Messrs. George Forrester and Co., of Liverpool, with J. Macfarlane Grays patent steering gear, and the large wheel for regulating it is 15 feet in diameter, and constructed in such an improved manner that it can be easily rectified in the event of a sea striking the ship while in a gale. The appliances for lowering and raising the anchors, which are four tons each, have been fitted by the builders on a new principle. Instead of davits projecting from the side, the anchors are raised with a steam crane, and swung down with ease and simplicity. In case of an outbreak of fire, pipes are fitted all round the deck, to which 22 jets, are placed in order for working, and the ship has Sir William Thomson's deep-sea sounding apparatus on board. Messrs. Robert Young and Son, Glasgow, supplied the compasses. The engines, said to be the largest of the kind ever constructed, are on what is known as the compound inverted three-cylinder principle, of 1,200 nominal and 6,000 indicated horse power. In order to work them with ease it has been deemed necessary to have six double-end boilers and 39 furnaces, the length of the latter being six feet each. The working pressure of steam is put at 90 lbs. and her contract speed 14 knots per hour. The ship is classed 100 A3 deck at Lloyd's, has four decks, and a promenade deck above all. She carries 10 boats, has two funnels, and is also fitted with steam windlasses forward. The Arizona has her bulkheads run up in such a way that if any of her water-tight compartments should get filled through collision or otherwise, she would still be seaworthy, and her scantlings are classed in the highest grade at Lloyd's. She has a crew of 150, all told, including seven engineers and 32 firemen. When running the lights from Cumbrae to the Cloch the engines went remarkably smooth, and she attained the speed of 17·3 knots per hour; the indicated horse-power was 6,557 or 557 in excess of the power required by contract.

Wanderer.—This magnificent new screw steam-yacht—perhaps the largest private vessel in the United Kingdom—which has been built at Greenock, for Mr. C. J. Lambert, of Park Lane, London, was recently taken down the Clyde on a preliminary trial of her engines. Being fitted with Perkins's patent engines, more than usual interest was centred in the trial, and on the invitation of the builders, Messrs. Robert Steele and Co., Greenock, a numerous party of scientific gentlemen and others interested in marine engineering were invited to witness the results. The following is a description of the vessel and her engines:—Length of keel and forerake, 175 feet, breadth, 29 feet, depth of hold, 16 feet 3 inches, draft of water forward, 12 feet 9 inches, draft of water aft, 14 feet 9 inches, tonnage (builder's measurement), 705 tons. She is built on the composite principle, all being in accordance with the rules of Lloyd's registry for a vessel of the 14 years class, and she is classed for 20 years by the Liverpool Underwriters' Association. She is fully-rigged as a three-masted schooner, with yards on the foremast, and her spread of canvas is quite in proportion to her size as a sailing yacht, being about 18,000 square feet, her main lower mast being 92 feet above deck. Although so taut, her great breadth of beam and weight of ballast, including 20 tons of lead in her kneel, will give her great stability. One of the principal objects aimed at in designing this yacht was, that in addition to her being a full-powered steamer she should also be thoroughly efficient as a sailing vessel. Every appliance has been adopted on board for the expeditious working of the gear. She has one of Harfield's patent steam windlasses, having a winch in connection with it for the working of the principal sails, or for the purpose of warping the vessel. Small hand winches are also attached to each mast. There is one of Downton's patent pumps, capable of drawing water from any compartment, or from the sea, for wash-deck purposes, and it is also arranged so that it can be used as a fire-pump. Half a dozen fire-extinguistvers are fixed below in different parts ready for immediate use. The yacht is fitted with engines and boilers on the Perkins system, in which a pressure of 500 lb. per square inch is used with absolute safety and with all the advantages derived from the increased expansion of the high pressure. From the experience already obtained there is every reason to hope that the economy at present realised by the ordinary compound engines will be doubled. In carrying out this system all the practical difficulties hitherto experienced in the use of steam of very high pressure—say 150 to 500 lb. per square inch—have been removed by the inventions and presevering experience of Mr. Perkins. To an ordinary observer the engines have all the appearance and simplicity of the well-known compound engine, whilst the boilers are noticeable chiefly by the small space they occupy, and the ease with which they are worked. With reference to safety, the system inaugurates an era of absolute protection from all the dire results of steam-boiler explosion. Of this there is not the least possible doubt, as the margin of strength is as thirty to one of the working pressure being a remarkable contrast to the present system, where six times the working pressure becomes a dangerous margin. Practically, the safety of the Perkins boiler greatly exceeds this comparison, as under any circumstance an explosion dangerous to life cannot possibly occur. The durability of these boilers is equal to that of the engines they work, and is secured by the use of perfectly pure water, and the amount required of such pure water is so small as to admit of its being easily provided for in the longest sea voyage. The introduction of this system opens up an era of steam engineering that admits of continued improvement, in contrast to the present system, which has now reached its maturity. Among the advantages realised by the adoption of this system in the Wanderer, are the saving of weight and space amounting to 25 per cent. in the former and to 30 per cent. in the latter. As it is impossible clearly and briefly in an article of this kind to give a technical description of these improved engines and boilers, it will be sufficient to state that there are three cylinders, having diameters of 17, 34 and 48 inches respectively, and a stroke of 30 inches, only two cranks being required as in the ordinary engines. The working pressure is usually 400 lb. per square inch, the safety valves are loaded to 500 lb., and the power realised is 800 indicated horse power, with a total weight of machinery of 130 tons. The speed attained by the yacht under easy steam was about 11½ knots an hour, but very much higher results are likely to be attained.

Bickerstaffe.—On the 24th May the trial trip of an iron paddle-steamer, built by Messrs. Laird Brothers, of Birkenhead, to the order of Messrs. R. and J. Bickerstaffe, of Blackpool, took place from the Mersey to Blackpool. The new craft is called The Bickerstaffe, after the name of her owners, and she is intended during the summer season to make excursions from Blackpool to the Isle of Man, Llandudno, Southport, Barrow-in-Furness, and other places of interest an the coast. She is 160 feet in length, 22 feet 6 inches beam, 8 feet 6 inches depth of hold and draws 5 feet of water. She is 334 tons burthen, 400-horse power, and her speed 14½ knots an hour. The Bickerstaffe left the Woodside Landing-stage about 11.30 a.m., and made the distance to Blackpool in 1hr. 33m. The trip was a very pleasant one, and the Bickerstaffe proved herself to be a very fast-going vessel.

Lord Collingwood.—On the 24th May the new iron screw-steamer Lord Collingwood, of Newcastle, belonging to Mr.

Charles Tully, Mayor of Tynemouth, and partners, was taken out to sea for her trial trip. On this occasion the first trial at sea was made of a new steam-steering gear, patented by Messrs. Donkin and Nichols, engineers, Newcastle. The Lord Collingwood was built by the Tyne Iron Shipbuilding Company, Willington Quay, and is of the following dimensions:—Length, 270 feet; breadth, 34 feet; and depth, 24 feet 6 inches. She is classed 100 A 1 at Lloyd's, having been built under special survey, and has a carrying capacity of 2,600 tons deadweight. The engines, by Messrs. R. and W. Hawthorn, of Newcastle, are direct-acting compound surface-condensing, of 170-horse power nominal, the cylinders measuring respectively 42 inches and 62 inches in diameter, and the stroke of the piston being 40 inches. The working pressure of the boilers is 80 pounds to the square inch. The engines are fitted with Messrs. Hawthorn's patent steam reversing gear.

The ss North Eastern..—This fine steamer; which has had new boilers put in, and her engines thoroughly overhauled, made a trial trip on May 24th. The owners (Messrs. Moran and Sanderson, Hull), invited a party of gentlemen to the trip, which extended as far as Withernsea, and which was made under most favourable circumstances, as regards weather, both out and home. Amongst the party were Mr. E. C. Twiss, Captain Wellesley, Dr. Wilson, Mr. H. W. Bainton (Beverley), Mr. Dobree, Councillor Rayment, Captain Gibbs, Mr. Connell, Mr. W. J. Pratten (of Messrs. Earle's Shipbuilding Company), Mons. S. Mouilleron, and Mr. Kirkus. The North Eastern, which has a carrying capacity of 1,450 Tons, left the roads about eleven o'clock. The trial of the boilers and engines was pronounced in all respects very satisfactory. The engines made 72 revolutions per minute, or seven more than with her old boilers, and before the engines were overhauled. They worked with the greatest ease, and the absence of vibration was particularly noticeable. The average speed was 9¾ miles, although the vessel was very light. The donkey boiler is on the new combustion-chamber principle, which possesses superior advantages. Altogether the North Eastern is as good as new, with the added advantage of increased speed. The boilers have been made by Messrs. Earle, who have also overhauled and repaired the engines. At one o'clock, off Spurn Point, the party sat down to an excellent luncheon, after which Mr. Twiss proposed the health of Messrs. Moran and Sanderson, and success to the North Eastern, and in a few graceful words alluded to the enterprise of the firm. Mr. Moran, in responding to the toast, alluded to the depression in trade, but he spoke hopefully of the future, and expressed his undiminished confidence in the steam trade as a field for investment. Mr. Sanderson proposed "Success to Messrs. Earle's Company," and with the toast the name of Mr. Pratten, who responded. The party were landed at Hull shortly before seven o'clock, having enjoyed a fine breezy trip, and the liberal hospitality of the owner. The North Eastern; which is commanded by Captain A. B. Law, afterwards left for Cardiff, where she will take in a cargo for Barcelona.

Arauco.—On May 26th the steamer Arauco, which was recently launched from Messrs. Gourlay Brother's and Co.'s yard, Dundee, for the Pacific Steam Navigation Company, made several runs in the river to test the efficiency of her engines. The result was highly satisfactory, and the vessel proceeded to Liverpool in the evening.

Vesta.—On May 27th the iron steamer Vesta, built by Palmer's Shipbuilding and Iron Company, (Limited), of Jarrow, to the order of Messrs. Pearson and Langnese, of Hamburg, for the Hamburg and London Steamship Line, for their passenger's and cattle line, went on her trial trip. The vessel is 224 feet between perpendiculars, 29½ feet beam, and 17 feet depth of hold, 100 A 1 class at Lloyd's, and built under special survey, schooner rigged. She has a long full poop to fore and end of the engine space, with accommodation for 40 first-class passengers, including ladies' cabin, top-gallant forecastle for Crew and Stokers between decks; cabins, &c., for 30 second-class passengers, including ladies' cabin, also for Officers in fore 'tween decks. There is water ballast throughout the vessel. There are engines amidships, and accommodation for Engineers. The vessel is fitted with Palmer's inverted direct-acting compound surface condensing engines of 160 horse power, indicating 850-h.p., with steam starting gear. The boilers are constructed for a pressure of 80-lbs per square inch, and the furnaces are fitted with Von Essen's patent smoke consumers. The vessel is also fitted with patent cattle fittings under the poop and main-deck, and has steam cranes, steam winch, and patent windlass and steering gear, and will carry, when fully equipped, a cargo of over 1,900 tons, the gangways, cranes, &c., being especially arranged for rapid discharging of cattle and cargo. Captain P. Witt will take command of the ship. On the measured mile a mean speed of 12 1-10th knots per hour was recorded. The steam steering and reversing gear was thoroughly tested, the time taken to put from full speed ahead to full speed astern being 4½ seconds.

Edinburgh Castle—On May 31st the trial trip took place on the Clyde of the Lochgoil and the Lochlong Steamboat Company's new boat the Edinburgh Castle, built by Messrs. Robert Duncan and Company, Port Glasgow. She was launched some weeks ago, and latterly has been fitting out in the Victoria Harbour, Greenock, where her machinery was put aboard by Messrs. Rankin and Blackmore, the well-known Greenock engineers. The vessel left the Steamboat Quay shortly after 9 o'clock in the morning, and proceeded to Lochgoilhead via Kilcreggan and Cove. She is 210 feet in length, 19 feet 6 inches in breadth, and 8 feet 3 inches in depth. The engine is what is technically known as a single cylinder diagonal engine, is of 85 nominal horse-power, and is wrought at a pressure of 50lbs per square inch.

Velocity.—On the 31st of May the iron screw cutter Velocity, built by Messrs. Raylton Dixon and Co., of Middlesbrough, for the Great Grimsby Ice Company (Limited), made her official trial trip to Grimsby, which proved in every way to be a great success, the speed attained averaging 12 knots. She is 130 feet long, 21 feet beam, and 10 feet 6 inches depth of hold, and is fitted with engines of 50 horse power nominal by Messrs. Blair and Co., of Stockton. This vessel, with three others of similar size, built by Messrs. Raylton Dixon and Co., last year will attend upon the large fleet of fishing smacks from Grimsby—carrying out ice and packing cases—and collecting the fish from them so as to bring it fresh to the market.

The Coleridge.—On June 1st the Screw steamer Coleridge, just completed by Messrs. M. Pearse and Co., at their shipbuilding yard at Stockton, had her trial trip. The steamer is 215 feet long, 32 feet beam, with a depth of 16 feet 8 inches. She is fitted with water ballast tanks in both holds, and is iron-decked throughout, besides having companions, skylights, &c., of iron also. Her gross measurement is 1,100 tons, with a carrying capacity of over 1,400 tons deadweight. The steamer proceeded under steam down the river to the Tees Bay, where the usual fixing and adjustments of the compasses was done, and preparations were made for a run. The vessel's engines are by Messrs. Blair and Co., being 110 horse power nominal. As soon as all was in trim on board, the steamer's head was turned towards the Tyne, and she proceeded. With the engines working up to 76 revolutions, the Coleridge fully averaged nine knots on the run from Hartlepool Heugh to the Tyne which was considered satisfactory. The steamer will load cargo in the Tyne for the Baltic.

The Shamrock.—On the 17th of June the new screw steamer Shamrock, the latest addition to the fleet of steamers owned by the Glasgow and Londonderry Steampacket Company, went down the Clyde on her official trial trip. The vessel has' been built by Messrs. A. & J. Inglis, Pointhouse. Her dimensions are:—Length, 231 feet; breadth, 31 feet; and depth, 15 feet 6 inches. She has direct acting compound engines of 220 horse power, working up to 1,550 indicated horse power. The diameters of her cylinders are 36 and 70 inches, her stroke 3 feet 9 inches, with a boiler pressure of 75 lbs per square inch. Her boilers are double-ended, with 12 furnaces. The steamer has been fitted up with all the latest improvements. She has accommodation for 72 first-class passengers, and is certificated for 802 steerage passengers. The steamer was steered first of all round by the mouth of Lochlong, and then over to the Wemyss Bay shore, where a trial of her speed was made between the Cloch and Cumbrae Light. The vessel attained a speed of 14·139 knots between the points named. The Shamrock is to be under the command of Captain Aitken, late of the Cedar (s). She is to be immediately placed on the Dublin and Glasgow route, to trade between which ports she has been specially built.

The Bedouin.—This steamer which has just been completed for the Liverpool house of Messrs. W. and R. Thompson by Messrs. C. Mitchell and Co., of Walker, sailed from the Tyne on June 13th after a satisfactory trial trip. With a total weight on board of 1,400 tons, including bunker coals and water ballast, the measured mile was twice traversed, the mean speed being 10·7 knots. During the whole day the engines worked with the utmost smoothness and to the entire satisfaction of all on board. Steam was constantly maintained at 80-horse power, giving an indicated horse-power of 930.

The Isabel.—On May 28th the new screw steamer Isabel was taken to sea on her trial trip. The Isabel has been built by Messrs. John Readhead and Co., South Shields, to the order of Mr. Robert Harrowing, of Whitby, and her dimensions are as follows:—240·6 × 32·6 × 17·55; her nett register is 819 tons, and she will carry 1,750 tons deadweight. The vessel has been fitted with compound surface condensing engines of 110 horse power nominal, manufactured by John Readhead and Co. The steamer, after having had her compasses adjusted, proceeded northwards as far as Newbiggen, to test her engines and speed. A speed of 11 nautical miles per hour was maintained. After the trial the vessel returned to the harbour, and immediately proceeded to Northumberland Dock to take in a cargo of coals for Constantinople.

NUEVO VALENCIA—The Nuevo Valencia, built by Messrs. Andrew Leslie and Co., Hebburn, had a trial trip off the coast of Northumberland last week. Her principal dimensions are 210 feet in length 36 feet beam, and 23¼ feet depth of hold. She is spar decked, and has accommodation for passengers. Her engines are of the compound surface condensing screw type of 120 n.h.p.. and contain all modern improvements for economical working, combined with the greatest effective power. They have been fitted by Messrs. Black, Hawthorn and Co., Gateshead, and gave most creditable results during the trial.

THE WATERLOO (s).—This new iron screw steamer, built by the London and Glasgow Engineering Company for Messrs. Allan C. Gow and Co., Glasgow, has ran her official trip from the Tail of the Bank, when, with 1,820 tons deadweight on board, she attained a speed of 10 knots per hour, which was considered highly satisfactory. The dimensions of the Waterloo are:—Length, 254 feet, beam 33 feet, depth of hold, 18 feet 6 inches. 901 tons nett, 1,398 tons gross, raised quarter deck 3½ feet high, with long bridge for Engineers, and in front large capacity for cargo There is also a topgallant forecastle for the Crew. She is also fitted with engines 130 horse power by her builders, and has a Napier's steam windlass and three powerful winches. She is built in excess of Lloyd's highest class, has a double bottom for water ballast in fore and after holds, and is especially adapted for the Mediterranean, Black Sea, and Atlantic trades.

AMOOR.—On the 21st June the iron screw-steamer Amoor left the Tyne for her trial trip at sea. The vessel has been built by Messrs. C. S. Swan and Co., of Wallsend, for the Mercantile Steamship Company, London. The following are the dimensions of the steamer:—Length over all, 292 feet; between perpendiculars, 285 feet; extreme breadth, 35 feet 6 inches; depth from top of beam to top of floors, 24 feet 6 inches. She is about 2,000 tons gross register, and her carrying capacity is 2,800 tons deadweight. The Amoor is classed 100 A 1 at Lloyd's. She is built on the three-deck principle, the main deck being of iron sheathed with wood, and is supplied with all the latest improvements on deck in the shape of winches, windlass, &c., also with water ballast in holes. The engines are on the compound surface-condensing principle, of 200 horse power nominal, and has been fitted by Messrs. Black, Hawthorn, and Co., of Gateshead. The steamer will be commanded by Captain A. Clark, late of the same company's steamship Tagus, and will be chiefly employed in the American trade. When the vessel got outside the harbour, the compasses were adjusted. There are two special improvements on the vessel which are worthy of notice, namely, Messrs. Brigham and Cowan's patent steam steering gear and hand gear combined, and Messrs. Durham and Co.'s marine engine velometer. During the trial the working of both these improvements was watched with much interest, and with entire satisfaction to all concerned, not a single hitch occurring with either. The engines also worked extremely well, and a speed of 10½ knots an hour was obtained. The steamer returned to the harbour about 5 o'clock. and was taken direct into Tyne Dock to load her first cargo for Genoa.

WHEATFIELD.—On the 21st June the screw steamer Wheatfield, built by Messrs. Palmer and Co., Jarrow, for Messrs. Hunting and Pattison, Newcastle, left the Tyne for a trial at sea, and afterwards proceeded on a voyage to Genoa. The following are the dimensions of the vessels:—Length, 270 feet; breadth, 35 feet; depth of hold, 24½ feet. Her nett registered tonnage is 1,277, and her carrying capacity is 2,800 tons deadweight. She has an iron main and upper decks, the latter being sheathed with wood. The steamer has been built extra strong, and is in excess of Lloyd's requirements, her class being 100 A 1. She has every requisite for the rapid discharging and loading of cargo, including four steam winches. The engines (supplied by Palmer's Company) are 170-horse power nominal, and 900 indicated; the cylinders are respectively 32 inches and 62 inches diameter, the stroke of the piston is 40 inches, and the working pressure of the boilers is 80-lbs to the square inch. The Wheatfield is intended for the general Atlantic trades, and her Commander is Captain Munroe.

NOTES AND NOVELTIES.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Mr. William Ord, engineer, to the Endymion, for tender; and Mr. John Kimber, engineer, to the Osborne.

The *Gazette* contains an official announcement that the Albert Medal of the second class has been conferred upon Mr. W. J. Bridges, quarter-master of H.M.S. Thunderer, in recognition of the services which he rendered on board that vessel at the time of the recent explosion.

A torpedo launch, en route for Liverpool, put in at Sheerness June 23rd, her machinery having broken down. It is said that the vessel is ordered for one of the belligerents in the South American war, and will be conveyed to the Pacific (unless detained by the English Government) in one of the packets sailing from Liverpool.

The torpedo boat Acheron.—The torpedo boat Acheron. which was built by order of the New South Wales Government, at the Atlas Company's Works, Darling Harbour, underwent its final trial in the harbour on Tuesday, the 1st June, and we learn from the Colonies and India, accomplished the speed of seventeen miles an hour, which is only slightly under that attained by the Thorneycroft torpedo boats. Mr. Norman Selfe, the designer and the Atlas Company, builders of the vessel, may be conratulated on the success of their efforts, which surpassed anticipation.

New French Torpedo Vessel.—The Compagnie des Forges of Chantiers de la Méditerranée have just supplied to the arsenal at Toulon a torpedo boat, whose length is 110 feet and width only 10 feet, the draught of water not exceeding 28 in. The speed attained by this vessel at the official trials is stated to have averaged 19 knots per hour. In the front of the vessel is a chamber furnished with a tube to receive a Whitehead torpedo of the largest dimensions When it is desired to launch the projectile the front of the vessel is opened by special mechanism, and the torpedo is projected into the water, either by means of a jet of steam or compressed air. As soon as the Whitehead torpedo has left the projecting tube it is propelled automatically by means of the motor contained within it, and pursues its course towards the object of attack at a speed exceeding 20 knots an hour.

The Pulsometer.—On Saturday afternoon, May 24th the s.s. Lord Collingwood, the latest addition to Messrs. C. Tully and Co's fleet, had her trial trip off Tynemouth, with very satisfactory results. She is the tenth vessel built for this firm by the Tyne Iron Shipbuilding Company, Limited, and was engined by Messrs. R. and W. Hawthorn. She is fitted with a pulsometer, now successfully used as a water ballast pump, and which is superseding the ordinary donkey pump. Since its adoption, about fifteen years ago, by Messrs. Farina and Bushell, consulting engineers, Newcastle, for the Racil a of Messrs. Stephens and Mawsons' line, no fewer than twenty vessels built on the Tyne and Wear have been fitted with it, besides others specified for vessels not yet launched. Previous to fitting it on board the Lord Collingwood, Mr. H. D. Furness, superintending engineer for Messrs. C- Tully and Co., and other firms, took every means, by trials and experiments, to satisfy himself of its merits, The result was, he decided to adopt it, not only for the Lord Collingwood, but also for two other steamers now building under his supervision. All Mr. Furness's anticipations have been fully realised, the pulsometer not only on Saturday, but also on its previous trials on board, having performed its work admirably. The following are some of the steamers referred to which have been supplied with pulsometers, viz., the Rowland, Regulus, Ranzani, Royal Dane, Earl Percy, Alton Tower Belsize, Cyprus, Celtic Monarch, Peninsula, Inchclutha, Inchmornish, Asi., Activity, &c. This shows that the North-country engineers are not slow in recognising the merits of any inventions or improvements brought before them, nor in adopting them when found to be of practical value.

Docкising the Avon.—Mr. J. Howard, engineer of the Bristol Docks, has drawn up a plan, with estimates, for dockising the Avon, and the plan is to be published next week. It is put in an alternative form—to throw a dam across the mouth of the river, at a cost, or estimated cost, of £770,000, or at Hungroad, below the Horseshoe Point, at a cost of £650,000 These estimates are, of course, independent of the drainage schemes, which the dockisation of the river will involve, and Mr. Ashmead estimates the sewage works of £280,000. In all, therefore, the two schemes may be said to involve an expenditure of £1,000,000 sterling.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act, of 1854 during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class: 2 C, Second Class.

Thomsen, John,	2 C	Livrpol.
Griffith, John P.	2 C	do.
Gilchrist, Wm.	2 C	do.
Brough, John ...	2 C	do.
Gordon, Wm. L.	1 C	London.
Saunders, Geo...	2 C	do.
Heck, Chas. E.	2 C	do.
Burton, A. W....	2 C	do.
Gill, John ...	1 C	do.
Mann, David D.	2 C	Aberdn.
Scott, Robt. C.	2 C	N. Shlds.
M'Laren, A. H.	1 C	do.
Sclanders, Jas....	2 C	Greenock
Simpson, Wm.	2 C	Dundee
Storey, John ...	2 C	Livrpol.
Moss, W. H. ...	2 C	do.
Thomson, Jas...	2 C	do.
Gardner, Wm...	1 C	do.
Campbell, Arch.	2 C	London.
West, Henry E.	2 C	do.
Hardy, Forster	2 C	N. Shelds
Patterson, F. W.	2 C	do.
Spoors, Robt. ...	1 C	do.
Gough, John ...	1 C	do.
M'Nair, Jas. ...	2 C	Glasgow.
Honeyman, P....	2 C	do.
Robertson, Wm.	2 C	do.
Cochrane, J.......	2 C	do.
M'Ausland, John	2 C	do.
Sutherland, G.	1 C	do.
M'Dougall, Jno.	2 C	do.
Millar, John ...	1 C	do.
Tod, Thomas ...	1 C	do.
Denny, John ...	1 C	do.
Peacock, John	1 C	do.
Husband. R. A.	2 C	Sndrland
Clark, Jno. ...	2 C	do.
Nedwell, Jno.	2 C	do.
Swales, Jno ...	2 C	do.
Carr, Geo. Wm.	2 C	do.
Thompson, T. C.	2 C	do.
Stamp, Geo. ...	2 C	do.
Warren. H. ...	2 C	do.
M'Cabe, P. J. ...	1 C	do.
Smith, Chas. ...	1 C	do.
Williamson, A W	1 C	do.
Oxley, Wm. ...	1 C	do.
Webber, Chas. ...	2 C	Sthmptn.
Powell, Phillip	2 C	do.
Todd, Chas. Wm.	2 C	Bristol.
Cloake, F. W. ...	2 C	do.
Dick, George ...	2 C	London
Brown, Wm. ...	2 C	do.
Thompson, Wm.	1 C	do.
Wilson, Robert	1 C	do.
Morrison, Wm.	2 C	Lvrpool.
Gilbert, James	2 C	do.
Brock, Arthur,	1 C	do.
Arthur, John A.	2 C	London.
Fraser, W. G. ...	2 C	do.
Hartley, George	2 C	do.
Galloway, Wm.	2 C	do.
Sinclair, Jas. F.	2 C	do.
Simpson, J. W.	2 C	N. Shields
Abernethy, G....	2 C	do.
M'Intosh, Alex.	2 C	do.
Burns, Joseph	2 C	do.
Harrison, Robt.	2 C	do.
Wardle, Michael	1 C	do.
Sharpe, Henry R.	1 C	do.
Melrose, Alex. ..	2 C	Leith.
Douglas, Wm. W.	2 C	do.
Paterson, James	2 C	do.
Wood, Alex. D.	2 C	do.
Fraser, Thomas	2 C	do.
Morton, Wm, ...	2 C	do.
Hankinson, Wm.	1 C	Plymoth.
Skrine, Tyron, J.	2 C	London.
Scanes, Walter	2 C	do.
Thomson, John	1 C	do.
Lillie John ...	1 C	do.
Gardner, Wm. N.	1 C	do.
Semple, Robert	2 C	Lvrpool.
Jones, Jos. W.	2 C	do.
Brownsmith, E. L	1 C	do.
Archer, William	1 C	do.
Brewer, James R.	1 C	do.
Corby, Chas. L. M.	2 C	Abrddeen
Addington, Wm.	2 C	Lvrpool.

Robert Jackson, Registrar-General.

General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

Recent Applications for PATENTS connected with MARINE ENGINEERING, SHIP CONSTRUCTION and MECHANICAL APPLIANCES for use in SHIPS, from May 16 to June 16.

Steam valves, G. V. Maxted, 1961.
Ship's bottom cleaner and assistance in repairing leaks, &c., H. Studdy, 1963.
Taps for cutting internal screws, (communication E. Dejone), A. M. Clarke, 1979.
Sextants, octants, and telescopes, G. W. Heath, 1984.
Winches, hoists, cranes and elevators, T. A. Weston, 1985.
Locks and lock gates for canals, rivers, &c., (communication J. Pouchet and G. Sautereau), A. M. Clarke, 1995.
Steam boilers, T. C. Watts, 2108.
Valves and cocks, T. Penn, 2025.
Air and water motors, (communication B. T. Babbitt), H. E. Newton, 2028.
Governor for marine and land engines, J. Sample, 2032.
Steam and other steering gear and motive power engines, G. A. P. Bremme, 2037.
Construction and propulsion of vessels, (communication R. H. Tucker), P. M. Justice, 2051.
Screw propellers, J. Fisher, 2057.
Sliding valves, P. Everitt, 2063.
Packing and material for driving belts, T. and A. Callender and A. B. Herbert, 2081.
Steering and stopping apparatus, T. B. Heathorn, 2082.
Scouring tidal channels, P. Protheroe, 2083.
Slide valves, S. Starkey, 2092,
Portable elevator, (communication A. W. Lamphere), A. M. Clarke, 2097.
Ships logs and speed recorder, W. E. Carlile, 2103.
Sheathing iron vessels to prevent corrosion, C. F. Henwood, 2113.
Cocks and valves, E. Marsden, 2114.
Steam engine indicators, M. Longridge, 2119.
Berths and Cots, R. Gillies, 2136.
Steam engines, F. C. Marshall, 2139.
Lubricant, P. M. Crane and R. Moir, 2160.
Boiler feeding apparatus, E. Tromentin, 2179.
Ship's bottom cleaner, J. C. Krogh, 2180.
Sounding apparatus, (communication P. Rousset), G. W. Nawrocki, 2185.
Compound engines, (communication R. Holz), C. Kesseler, 2188.
Furnace fire-bridges, W. Anderson, 2190.
Lamps, F. Siemens, 2231.
Casings, J. Bell, 2237.
Order transmitter, J. S. Slarnes, 2238.
Steering engines and gear, J. H. Wilson, 2246.
Boilers, furnaces, and furnace doors, T. Lancaster, 2247.
Operating machinery by tides, G. Allix, 2248.
Wreck-raising apparatus, W. Coppin, 2260.
Furnace draught regulator, (communication D. C. Kellem,) W. R. Lake, 2263.
Light signalling apparatus, C. O. Ramstedt 2268.
Screw propellers, G. J. Stevens and J. S. Smith, 2270.
Sounding apparatus, T. Bassnett, 2275.
Propellers, (communication J. L. Nevers), A. M. Clarke, 2280
Steam pumps, J. Wolstenholme, 2283.
Wicks for lamps in lighthouses, &c.. J. Freeman and A. E. Webb, 2285.
Paint for submerged structures and ship's bottoms, T. and W. H. Wilson, 2286.
Safety valves, T. Lee, 2297.
Variable expansion valves, (communication A. Bretonneau), A. M. Clarke, 2303
Flood-gates, sluices, &c., J. B. Mannix and W. S Cox. 2316.
Motive power engines. W. E. Wish, 2328.
Steam boilers, J. Shaw, 2355.
Steering apparatus, W. Y. Fleming and P. Ferguson, 2355.
Improvements in ships or vessels, J. C. Brown, 2358.
Rotary engines, (communication F. Pernot), J. C. Newburn, 2382.
Ship's boat disconnecting gear, J. Sample, 2384.
Construction of ship's, W. Coppin, 2388.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is Five Shillings per annum. Post Office Orders to be made payable to W. G. Neal, of 3, Amen Corner, London, E.C., at the Ludgate Circus Money Order Office.

The Marine Engineer,

LONDON, AUGUST 1, 1879.

EDITORIAL NOTES.

DO any of our readers understand the distinction between the dynamical and statical energy of steam? This is a subject of much interest, and of which little is actually known by way of comparison. Any practical results or experiments leading to such effective comparison would be gladly acceptable to ourselves, and we think also to the world at large. We will explain what we mean, and what we know about the matter. When steam is generated in a boiler in the usual way, and its elasticity is then converted into work in the cylinder, this is developing the statical energy of steam, which of course is usually and easily estimated in the form of indicated horse-power. But take the case of an ordinary injector or ejector. In this apparatus the body of steam and water is open to the atmosphere. through the overflow orifice, and in such case there cannot be any statical or elastic pressure developed by the steam to drive the water forward. It would be found that if a pressure gauge were tapped into the body of the injector no pressure whatever would be indicated, but rather a vacuum, if anything. How then is the work effected of driving a stream of water into a boiler against boiler-pressure? The work is effected by the dynamical energy of an issuing jet of steam at an exceedingly high velocity, which by combining with a jet of water, also made to travel in the same direction, exerts an enormous force, but only as a dynamical momentum developed in the direct line of motion. A very neat problem then presents itself to us. Given a pound of steam at, say 60 lbs. above atmosphere, in which of the two ways, statically in a cylinder, or dynamically in an ejector or injector, can the most energy be obtained from it before dissipation?

WE are glad to see that the scientific, and consequently improved social position, of marine engineers of the Royal Navy, is now meeting with better consideration at the hands of the Admiralty. A notice of competitive examinations for engineering studentships in Her Majesty's Dockyards has been inserted for some time during the commencement of the year. Forty vacancies were filled up in May last, and the number of applicants far exceeded the vacancies offered. Again the Admiralty and the Committee of Lloyd's have each established a schrlarship of £50 a year, tenable for three years, to be competed for by the students of the Naval College. If the Admiralty is now taking so much trouble to secure a marine engineer of the future, who shall have undergone a specified scientific and practical training, there will no longer be any possible or valid excuse to withhold from them, as a class, an equal social recognition with their *confreres* of the service. What we should like to see adopted in the Navy, would be a larger number of skilled artificers or enginemen placed in a similar position to the petty officers, and officered by three or more engineers-in-chief and assistants, who should be men of education and position, equal to that of their brother officers of the executive class. The artificer and engineer would thus no longer be confounded together.

THE battle of armour-plating *versus* guns, is still being pushed forward with vigour. A new success to the armour has just been scored during the last month, at Portsmouth, by compound steel-faced armour-plates. This class of plate is to be adopted for the turrets of the Inflexible, and the sample plate has passed a very successful ordeal. Steel plates *per se* are not successful as protecting armour, for although they very successfully resist penetration in a much higher degree than iron plates, they shiver under the shocks of the projectile so as to drop in pieces from the sides of the ship. Sir Joseph Whitworth and others have already succeeded in producing a steel so hard that shot—even Palliser chilled projectile—have plastered themselves upon it without the power of penetration. The brittleness, however, of these plates caused their destruction even more rapidly than if they had been pierced, consequently many have a decided preference for the old wrought iron plates. Messrs. Cammell, however, have pushed the advantages of a compound steel-faced armour forward, though at first with poor success. It was found that the welding between the plates was so inperfect that the steel-facing, when shivered by the shot, fell away from the backing of wrought iron, destroying the weld. A remarkably successful improvement has, however, just been perfected by Mr. Wilson, jun., and adopted by Messrs. Cammell, in the method of welding the steel face to the iron backing. The iron plate is first heated in a furnace, of which it forms the bed, to a good red heat, and when in this condition molten steel from other furnaces is allowed to flow upon the iron plate to the required depth, and to cool there. As the temperature of the fluid steel is much in excess of the welding temperature of iron, the surface of the latter becomes partly fused by the overlaying liquid metal, and a complete weld is thus produced between the iron and the steel. The fusion is so complete that the distinct characters of the two plates are no longer markedly divided but the carbon of the steel diffuses into the iron so as to produce a gradual gradation from steel to steely iron, and from steely iron to pure iron, through a space of about half an inch. The test was a severe one and consisted of three 250lb. Palliser chilled shots, at a range of 30 ft., from a 12-ton 9-inch gun. All three shots splashed on the target—which was 3½ inches of steel on 5½ inches of iron—without penetration, and in no case did the cracks, which were comparatively local, penetrate as far as the iron backing, neither did any of the shots succeed in getting through the steel surface. So highly was the result of this test thought of by the officers and gentlemen present, that an opinion was expressed as to a revolution in iron plating in favour of compound plates, which have also proved much superior to plates wholly made of steel.

Although there was this year no china tea race, the new Glen liner, Glencoe, has made the fastest passage on record. Leaving Woosung, at the mouth of the Shanghai river, on the 27th of May, she arrived off Gravesend in the extraordinary short space of 37 days out, viz., on July 3rd. This is certainly a most astonishing passage, but one of the most striking features of the age is the ever-increasing demand for speed. It is curious to compare such a result as that we have just instanced, with the doubt and hesitation of Mr. Brunel, and Dr. Lardner, as to whether steamships could be constructed to cross the Atlantic. This problem was first settled in 1838, when the Sirius from London, and the Great Western from Bristol, made their successful voyage to New York. In 1840 the Cunard line began their regular mail service between Liverpool and Boston. The famous Britannia, in which Dickens made his first trip to the United States, would now make but a poor comparison with the latest improvement by that line, viz., the Gallia. The Britannia was 1,139 tons burden, 207 feet in length, 34ft. 2in. in breadth, and 22ft. 6in. in depth. Her nominal horse-power was 425, and her speed about 9 knots, requiring double the fuel to drive her at that speed that the Gallia requires at 16 knots. The Gallia is 450 feet in length, 46 feet broad, 36 feet deep. Her tonnage is 4,809, and her engines work up to 3,500 horse-power. The growing tendency to effect the quickest passages across the Atlantic have had both a good and a bad effect. The good effect has been to promote the building of such splendid fast ships as the Gallia, the Arizona, the City of Chester, the City of Berlin, and such splendid liners. The bad effect is the danger constantly on the increase of collision at sea, owing to the strong inducement not to slacken speed even in foggy weather. We think a track should be as defined between here and the States as a railway with an up and down line. There should be no difficulty in the regular liners adhering pretty closely to a recognized track West and again to another Eastwards. In this way the two great streams of traffic might be kept so wide apart and each to itself that the risk of collision need be very small.

It seems that the circumstances causing the explosion of the 38-ton gun, on board the Thunderer, are not universally accepted amongst the authorities as satisfactorily settled. We are all aware that the Committee upon the question have decided that the gun was fired with a double charge, which would certainly have been sufficient to account for the accident. On the other hand, it does still seem difficult to believe that neither the failure to discharge was noticed by the gunners, nor that the pressure of a double charge, which would fill the barrel two-thirds of its length, was noticed by those in charge of the loading apparatus. Sir Wm. Palliser seems to be very sceptical on this point, and advanced private experiments of his own which, to his mind, serve to prove that the fracture and peculiar scoring of the inside tube might have been produced by a single shot tripping on the *papier mache* wad, some distance in front of it. He maintains that in such a case the heel of the shot would cant up and score the barrel, as noticed, and at the same time, by its wedging action in the thinner part of the tube, burst the gun. A stud, however, has been found in the turret, which the Royal Laboratory pronounce unhesitatingly to be one from a Palliser shell. If this stud can be confidently identified, it proves the conclusion to which the Committee arrived, as the Palliser shell was part of the first charge, not of the second. However, we are likely to have the question soon definitely settled, as we hear that definite instructions have been given to the War Office Committee, which is shortly to assemble to investigate the whole question of heavy guns, to test the twin 38-ton gun of the Thunderer to destruction. We shall watch the results with interest.

ALDERMAN'S PATENT CAPSTAN.

In a former issue we drew our readers' attention to the advantages attaching to Mr. Alderman's Patent Windlasses, Capstans, Bow Stoppers, and Compressors. We this month are able to give illustrations of the arrangements most usually supplied by Mr. Alderman. As the object, both of the riding-bitt capstan and of the self-acting bow-stoppers and compressors, is to give the greatest facilities for promptly purchasing the anchor or paying out the cable, this arrangement should recommend itself to shipowners and captains for the convenience offered in handling the ship. Or again, as the effect of the arrangement is a security to the sailor in paying out the cable, or purchasing the anchor, whereas at present their lives are sadly endangered, the absolute necessity of such an arrangement ought to impress itself upon shipowners as a matter of humanitarian duty.

These patent windlasses (Fig. 1) are so constructed that when purchasing the anchor, a chain-wheel or cable-holder (*a*) is used in combination with a windlass-barrel or drum (*b*), the cable is gathered in by the cable-holder, and is transferred from it to the drum or barrel of the windlass, and passed away to the locker (*c*). The chain thus entirely encircling the windlass is held securely in the chain-wheel, and is prevented from surging and running out; and the shackles, large links, and unequal links of ordinary cables are held and worked with facility and safety: as may also be cables of different sizes in the same wheel. When letting go, and when veering, the barrel or drum and the chain-wheel are disconnected, and the wheel being free to revolve in a contrary direction, the chain is no longer held by it, but passes out round the barrel or drum, and the ship is brought up, and the chain checked and held, or eased away by means of the compressor (*d*) with a round turn—or more turns than one if needful—round the barrel or body of the windlass.

Upon the capstan (Figs. 2 and 3) the same results are obtained in the same way. The cable is gathered in by a chain-wheel at the foot, combined with the barrel or body of the capstan, and is transferred as it comes in from the chain-wheel to the body of the capstan, which it entirely encircles, and round which it may be veered away as round a riding-bitt; *riding-bitts and guide-rollers being thus altogether dispensed with*—these guide-rollers being the cause of frequent accidents.

Alderman's patent cable stoppers (*e*) and compressors (*d*) are well known and appreciated. They pall each link as it passes inwards; yet the chain can be released and allowed to run out, or veered away fathom by fathom, and checked and held again as required.

These recently patented improvements in cable machinery, being strongly constructed and composed of few parts, are not liable to break, get out of order, or otherwise occasion outlay for renewal or repairs.

The whole arrangement, as above described, is very simple and effective, and we are glad to hear has already been largely adopted.

The stoppers and compressors are used with the windlass, in the same way as described with the capstan.

Alderman's Patent Capstan and Windlass.

FIG. 1.

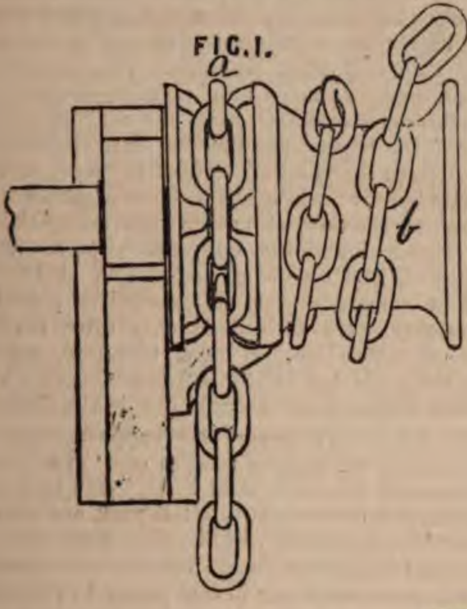


FIG. 2.

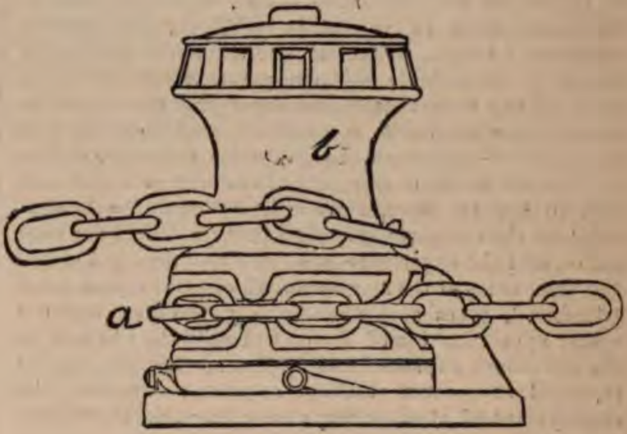
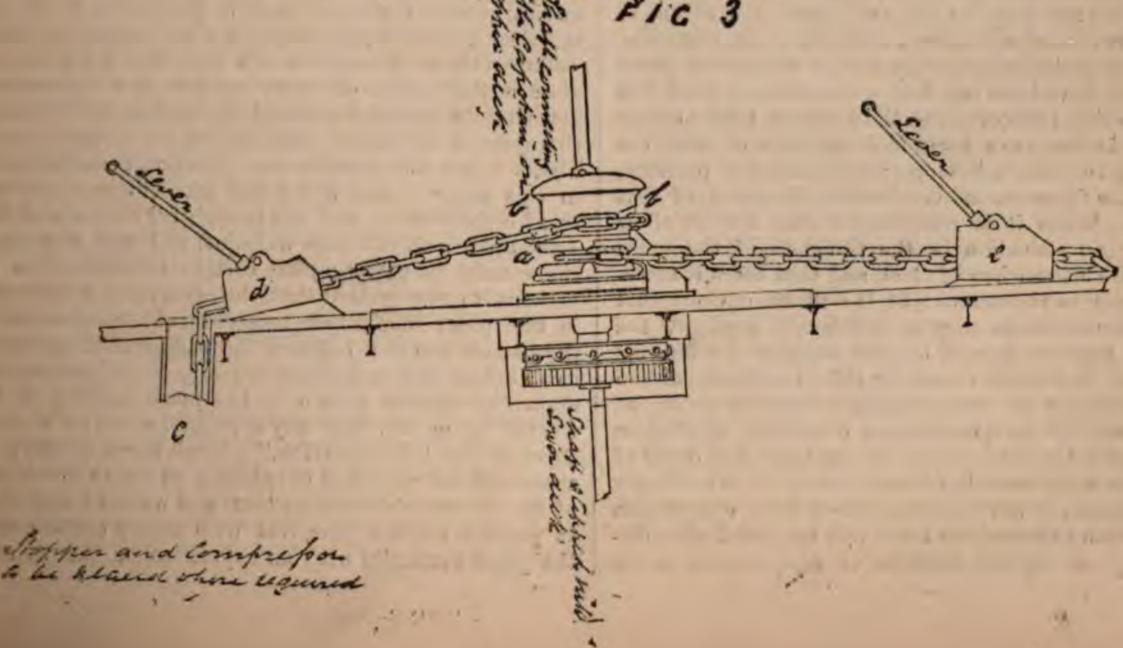


FIG 3


Shaft connecting with Capstan on Upper deck
Lever
Lever
b
b
a
d
e
c
Shaft & Capstan with Lower deck
Stopper and Compressor to be placed where required

FRACTURES IN STEEL.

UNTIL within the last few years, the application of steel in ship and boiler construction, in the mercantile marine, has been almost entirely restricted to vessels intended for special purposes of trade, in which swiftness or shallowness, and consequently lightness of structure, have been necessary conditions; and from all accounts, regarding the performance of such vessels, they would appear to have invariably given much satisfaction. It has been regarded by some as a matter for surprise that steel made such slow progress in these branches of industry in former years, and we have not been wanting in a variety of explanations respecting this neglect of steel. Although the result was not due solely to any one single cause, there are one or two circumstances in connection with the early history of the introduction of steel for shipbuilding which will readily occur to those whose experience carries them back to that time, as affording satisfactory explanation of the temporary "shelving" of the new material. We need only mention, for instance, the great difference then existing between the price of iron and the price of steel, to appreciate the reluctance shown to employ steel in the construction of vessels intended for the general purposes of trade. There can be little doubt that by far the most formidable obstacle presented to the more extended and general introduction of the use of steel in former years was, not so much the reputed uncertainty of the material—although the prejudice existing on this point in the minds of numbers of eminent practical men was, to say the least, sufficiently strong and unreasonable—as the comparatively high price prevalent for steel plates, and the experience we have had during the last two years or so, of the manner in which steel is becoming introduced, gives ample evidence of the fact that the nearer approximation of the cost of mild steel to that of the commoner classes of iron, will assuredly remove the principal and most telling argument against the employment of steel—always providing that the cheapening process does not necessarily involve any material deterioration in quality, as a tendency in that direction would of course prove fatal. A glance at the number of marine boilers constructed more or less of steel during the past two and a-half years, will show the extent to which cost enters as a factor in the choice of materials. It has been stated on authority that in that period about 120 vessels have been supplied with boilers of steel, but it appears that little over one-third of the total number of those boilers have been built entirely of steel, the remaining two-thirds having only the internal portions, such as the furnaces and combustion chambers, of that material. When it is remembered that Lloyd's allow pratically no reduction in the thickness of the inside parts of the boiler when of steel, and that there is therefore no gain as regards weight, it will be obvious that the great advantage in price which mild steel now has over the superior brands of iron suitable for internal work must be the sole reason for this nice discrimination in the selection of steel; while on the other hand, the inferior quality, and consequent cheapness, of the iron available for the shells of boilers, supplies the cause of the comparative scarcity of steel shells. It is no longer open to doubt, however, that in the future competition between iron and steel the latter will be placed at no disadvantage as regards lowness of cost, thanks to the possibilities created by the important improvements in the present modes of manufacture indicated in the invention of Messrs. Thomas and Gilchrist.

Those who are inclined to find fault with our naval architects, for not having long ago adopted steel exclusively, may possibly find some consolation in the general desire to make some slight amends for past neglect by the profuseness of present attention; for while there are not wanting those who still cling to the traditional idea of the treacherous nature of steel, and are ready to prophecy all sorts of disasters of its use, the great majority of shipbuilders and engineers are desirous of giving the material a fair, impartial trial.

The firm grasp which the question has taken of the attention of our naval architects is sufficiently indicated by the prominence given to the subject at the constantly recurring meetings of our principal Institutions; and of recent discussions affecting the relative merits of iron and mild steel for the purposes of naval construction, probably the most important and influential was that which took place at the last gathering of the members of the Iron and Steel Institute. The proceedings in question possess a more than ordinary interest for the shipbuilder and engineer, from the very practical character of the papers, and the fact that the subject was treated from the point of view of the user, rather than the manufacturer, while the position of those who contributed to the subject entitle them to speak with no small degree of authority on questions pertaining to the working of iron and steel, and should at least afford sufficient guarantee that the conclusions placed before the meeting were arrived at only after careful and mature consideration. It may, therefore, not be unprofitable if we lay briefly before our readers a few of the more salient points brought out in the discussion.

Mr. Adamson's paper was supplementary to the valuable and exhaustive treatise on "The Mechanical Properties of Iron and Mild Steel," read by him at the Paris meeting of the Institute last year, and was indeed, in the main, simply an amplification, with such qualifications as further experiment had shown to be necessary, of a statement occurring in that paper, to the effect that drilled plates, as a rule, carry a slightly higher tensile strain through the line of hole in proportion to the sectional area of the metal left than a solid section of plate. Taking this proposition for his text, Mr. Adamson explained the result of some careful and interesting experiments he had conducted on the flow of force and the velocity of strain, from which he deduced some highly instructive conclusions. The point touched upon in this paper is one which has hitherto received but scant consideration, and the thoughtful remarks of Mr. Adamson are all the more welcome, and will well repay the careful perusal they are certain to receive. It is, perhaps, to be regretted that the observations contained in this paper should have received so little attention in the discussion which followed the reading of it and other two kindred papers, but this can only be assigned to the absorbing interest shown in the more exciting topics treated of in Mr. Barnaby's paper on "The Use of Steel in Naval Construction." Much as we should like, space will not permit of us entering now into the details of Mr. Adamson's investigations, and we must therefore at present content ourselves with merely stating that the paper concludes with an expression of the writer's

decided conviction that, with larger experience and careful application, the highest and strongest class of steel, the use of which has hitherto been confined chiefly to tool-cutting purposes, may be employed with perfect safety, and in many cases at much less cost in structures which are at present usually composed of the poorer class of iron.

Mr. Barnaby's paper dealt with the failures that have recently been experienced at Chatham Dockyard in a number of steel angle bars, and was the occasion of one of the fullest and most important scientific discussions we have ever had the pleasure of listening to. It is indeed scarcely possible to overrate the importance of the wide and far-reaching issues touched upon in this paper, which, as was pointed out by several of the speakers, virtually resolved itself in some respects into an attempted solution of the exceedingly large and obstruse question of the relative merits of the steel produced by the Bessemer Converter, and that manufactured on the open-hearth system; and that the full significance of some of the conclusions suggested by Mr. Barnaby was thoroughly appreciated, was observable in the tone of the more prominent speeches. It appears that in several instances the steel angle bars supplied to the Admiralty have been found to fracture in an astonishing manner. The cracks have not been confined to any particular stage in the process of manipulation, but have occurred in some cases after the angles had been worked, and before they had been annealed; at other times, after one-half of the length of bar had been in the annealing furnace, and occasionally even after the operation of annealing was quite completed. Mr. Barnaby is at a loss to account for the remarkable behaviour of these bars, which had in every case previously fulfilled the ordinary best conditions, and he fails to see how these tests can be so extended as to embrace the detection of the hidden cause of such results. What at first sight appears most strange is, that a material which in its normal condition has an elongation of over 20 per cent., and stands the severe forge tests applied to it should, under any ordinary conditions of working, crack in this sudden manner without having stretched at all. There was no suggestion that the angle bars that failed were of exceptional quality as compared to the general mass of angles supplied by the same firm, but it was mentioned that all the fractures had taken place in bars made of Bessemer steel; and as no similar failures are recorded of the Siemens or open-hearth steel, the inference is that steel angles turned out from the Bessemer converter are in some way or other inferior to and less reliable than the open-hearth material. Mr. Barnaby stated that, with the exception of resorting to annealing when a bar has been bent hot, the treatment given to the steel angles is much the same as that adopted with iron angles, and this includes bending cold whenever it is possible to so treat the bar. When appealed to for some explanation of the serious defects in these angle bars the manufacturers of the steel take exception to the practice of bending cold, and also to the manner in which the operation of annealing is conducted. It has generally been accepted, as being beyond question, imperatively necessary to avoid local or partial heating in working steel, and when there are circumstances in the case rendering local heating unavoidable, the material so treated should afterwards be annealed—that is to say, the *whole* of the plate or angle ought to be heated uniformly to a dull red, and allowed to cool. But in Mr. Barnaby's instructions to those employed in working steel in the dockyards, we find the following passage:—"If it is inconvenient to perform the operation of annealing at one time for the whole of a plate or bar, portions of the length may be annealed separately." An ordinary observer may find some slight difficulty to understand wherein lies the great difference between ordinary local heating—the injurious effects of which require to be provided for by subsequent annealing—and this partial annealing, which is employed as a finishing touch; and it would be interesting to learn whether the Admiralty have made investigations into the matter, before departing from the general practice of those engaged in the use of steel, both in this country and elsewhere, or whether, dispensing with the annealing of the plate or bar, as a whole, is merely a matter of convenience. If experiments had been made which showed that this partial annealing supplies all that is required, it may be concluded that the results would have been forthcoming; while if the process has been adopted only as a matter of expediency in the face of antiquated unsuitable plant, many will think that failure has in a measure been courted and grave risk thoughtlessly and needlessly incurred. One of the speakers touched upon this aspect of the case, and asked for further information as to the effect of partial annealing, but in his reply, Mr. Barnaby did not offer any additional particulars bearing upon the point.

So far as was apparent from the speeches of several gentlemen connected in various ways with mercantile shipbuilding, those failures in H.M. Dockyard find no parallel in the experience of private shipbuilders who have been employing angles both of the Bessemer and of the open-hearth manufacture. This exemption from fracture may be due, as was suggested, in some degree to the fact that angle bars used in merchant ships are not required to undergo such "torture" in the course of working as is necessary with angles intended for our armourclads; but this plausible attempt at an explanation is far from satisfactory. The specimens of steel produced at the meeting, worked into all manner of fantastic shapes, do not bear out the suggestion that a little more or less twisting or bending would make so much difference in a material having such ductility. It was also asserted on the authority of Mr. Martell that the smithies in our shipbuilding establishments are not nearly so much exposed as the workshop at Chatham, where the fractured angles were worked, and he was of opinion that the unfavourable situation, and the unexampled severity of last winter, with its cold chilling blasts, could not but have an unhealthy effect upon a material so sensitive as mild steel. In the present incomplete state of the matter it would be premature to venture upon any decided opinion as to the actual cause of the difference between the results obtained by private shipbuilders, and those experienced at Chatham; but we would be inclined to look at it from the point of view presented in the remarks of Mr. John, who stated that it is the practice at all shipbuilding yards where steel is used to anneal the plates and angles in their entire length at one time. If it is possible for a private shipbuilder to erect an annealing furnace of a size sufficient to anneal the frames of large ships at one heat, surely it is equally within the power of the Admiralty to provide suitable accommodation for a like purpose in the Dockyards.

But while thus indicating the point towards which further inquiry in the matter should probably be directed, we are perfectly free to admit that there are points of difficulty in respect of the behaviour of the steel bars at Chatham upon which we do not see our way clearly, but which we are quite content to leave to further experience, which alone will furnish an abiding and satisfactory explanation. Cut-and-dry theories are not hard to find, and their authors generally experience little difficulty in squaring facts to suit them, but, as a rule, they seldom afford much satisfaction to others, however ingenious they may appear; and it need only be further remarked that all the explanations that have yet been offered, of the cause of the fracturing in the steel angle bars, fail to account for the ruptures being confined to the steel of one particular manufacture—which, in the eyes of many, is the cardinal point of the whole matter.

Although there do not appear to have been any corresponding failures observed in the steel angles used in private shipyards, results of a somewhat similar character are by no means unknown in the manipulation of steel plates, and it may be advisable, in connection with the subject of the fracturing of steel angles, to consider the manner and probable cause of the cracks that have been discovered in steel plates. From the information given by Mr. Parker, in a very interesting account of a few cases of this nature, we gather that the number of steel plates that have been known to fail is not alarmingly large, and, what is of more importance, that the fractures have invariably been traced to causes which only require to be made known to be easily avoided. So far as Mr. Parker was able to ascertain, there have been only ten steel plates that have failed during the past two years, and eight of those have come under his immediate notice, and the "surrounding circumstances of each case have been carefully investigated, with a result that leaves no question as to the so-called 'mysterious' fractures being directly attributable to improper or careless treatment. All these plates were being used in the construction of boilers, and had satisfactorily stood the requisite tests. In one case the boilers were almost built up, and the men were engaged rivetting the furnace fronts, when the furnace plates cracked from the rivet holes for a distance of eight inches, at the side opposite that which was being rivetted. Upon inquiry, it was found that the furnace plates were slightly less in diameter than the front plates to which they were to be attached, and in order to make them accommodate themselves to the larger diameter, the furnace plates were partially heated, hammered and drawn in the process of rivetting; and Mr. Parker has no doubt that this treatment set up an excessive local strain sufficient to cause the plates to tear as described. Another instance of fracture occurred in the plates forming the back of a marine boiler. They had been flanged all round in local heats, and were afterwards annealed in the usual way; on being bolted to their places it was found that the flanged parts did not ply closely up to the shell where they lap, and in order to remedy this the workmen lit a fire under that part, as they would have done with iron plates, and hammered and plied the plates to their places. A short time after cooling the plates tore from the rivet holes—"in one case 2ft. 6in. from the part that had been "heated and hammered, and in the other 5 ft., for a length "of about 30 inches across the plate." These cracks occurred in consequence of the elementary precaution of employing annealing after local heating having been disregarded. As the result of his wide experience in the matter, Mr. Parker states that although most of the cases of fractured steel plates were at first sight surrounded with an air of mystery, a closer and more careful investigation has invariably disclosed the causes to be due, not to faulty material, but rather to the manipulation of ignorant or careless workmen. This is very satisfactory and reassuring, and gives some ground for the hope that, as the workmen in our ship and boiler yards become better acquainted with the peculiar properties of mild steel, all cause for anxiety regarding these unwelcome fractures will disappear. It would perhaps be too much to expect this happy result to be attained without further failures, as workmen who have spent years in the working of iron plates may be a little slow to apprehend the great difference required in working steel, and the occurrence of a fracture is perhaps the most cogent argument of which they are susceptible.

We need not follow Mr. Barnaby in detail through the results of his experiments to show the effect of punching on Bessemer steel plates, as compared to Siemens steel, and which gave a decided advantage to the latter material. The conclusion that Bessemer steel suffers considerably more from punching, unless subsequently annealed, than Siemens steel, was arrived at upon the result of "*four* very carefully made "tests," and of "*eight* tests," some of which were not "entirely "satisfactory." When it is considered what immense issues hang upon this question, it seems clear that Mr. Barnaby is not open to any accusation of having been lavish in the matter of tests; and although Mr. Barnaby himself appears to accept these tests as being in themselves conclusive proof of the inferiority of Bessemer steel, there will be few who, in the face of the extensive series of experiments that have been before the public for some time, and which differ in some important respects from the present tests, will be so readily satisfied. We are far from desiring to impugn the strict accuracy of these tests, *so far as they go*, but they cover only an inch of the outstretched mile that will have to be trodden before this matter is placed on a satisfactory footing. Mr. Barnaby's conclusions may be right, or they may be wrong, but he has not proved that they are right. As Mr. Lowthian Bell said, the question of the relative merits of Bessemer and of Siemens steel is one which it is quite legitimate to discuss, when all necessary information has been fully supplied, but it is not desirable to invite a comparison between the two kinds of steel as a side issue, and on so slender a basis as the results of a mere handful of undigested tests. It is beside the mark for Mr. Barnaby to urge the inconsequent plea that, being a neutral, entirely disinterested party, he should not be called to account for what in another might be deemed inadmissible. No one suspected the purity of Mr. Barnaby's motives, although many suspected the representative character of his tests; and while his high official position bestows many privileges, it has corresponding responsibilities, and does not carry with it the liberty to generalise upon insufficient data without being called to account.

We may return to some other features of the subject a short time hence, but we may fairly say that, on the whole, there was a general concensus of opinion that the days of iron in naval construction are numbered, and that in all probability a few years will suffice to see its final *burial!*

THE amount spent in the several dockyards in the year 1878.79, was £378,304; the amount proposed to be spent being £397,067. The amount spent on armoured ships was £205,000, and for unarmoured ships, £173,304; the amount proposed to be spent being £237,909, and £159,158 respectively.

SCREW PROPELLER TESTING MACHINE.

WE have already expressed our opinion that much has yet to be learnt by practical engineers and theorists alike, as to the action and effect of different classes of propellers. In proof of this opinion, we need only refer to the numerous cases well known, in which alterations to screw propellers, either accidental or experimental, have produced unexpected results upon the speed of the ship. We remember well an occasion on which the top of a blade to a screw propeller gave an unexpected increase of speed, and the case of the Isis was public property, in which the required maximum speed was only obtained after the experimental substitution of different classes of screw propellers.

The only valid excuse for such comparative ignorance lies in the fact, that the theoretical laws governing the form and area of screw propellers are not cases of application, and invariably result in a necessary compromise between advantages and disadvantages, both arising from the same cause.

We will endeavour to outline some of these considerations. First, the area of the propeller should in all cases be designed for each individual application, and should bear a suitable proportion to the resistance to motion of the vessel to be propelled. The conditions thus of a fine-lined steam yacht, and a screw tug of even equal displacement, would be opposite extremes as affecting the area of the screw. But the area of the propeller should be reduced to the least effective minimum, as excess of area means increased resistance to rotation, and frequently a hindrance to the free delivery or motion of the back-water. Where is the most effective mean?

Secondly, where in the blade is the most effective position for the maximum area? The position of greatest effect is at the point of maximum speed—that is, the extreme circumference. But again, the resistance to motion and the churning effect is greater as the distance of the arm from the centre increases, and any portion of the blade not utilized for absolutely pressing back the water is uselessly churning the same. Hence the value of a central boss, instead of connecting arms.

Thirdly, what is best longitudinal pitch for the thread of screw propellers, and what conditions govern this pitch? Should it be constant for a given resistance of thrust and a most convenient speed of engine, or should it vary with the condition of the water, river, or tideway, in which the vessel has to moor?

Fourthly, what is the most correct way of theoretically estimating the resistance of a vessel to passage through the water? Is it best estimated by midship section alone, by longitudinal frictional surface alone, or by what combination of both these considerations?

Fifthly, is the most beneficial effect produced from one large propeller or from two smaller propellers driven by equal power?

Sixthly, what effect has the condition of the back-water upon the effective action of the propeller, and in what way may the back-water be most effectively brought to the propeller for maximum result therefrom.

We rather think that a very large proportion of those in whose hands the adaptation of propellers to certain purposes may lie, would have very great difficulty in answering satisfactorily the above queries. We illustrate herewith Mr. Richardson's experimental apparatus for deciding the thrust of hulls and the slip or general results of screw propellers, which we should think is just the sort of apparatus that every manufacturing marine engineer should be supplied with, to know what sort of hull he may be called on to engine and what sort of screw would prove most satisfactory.

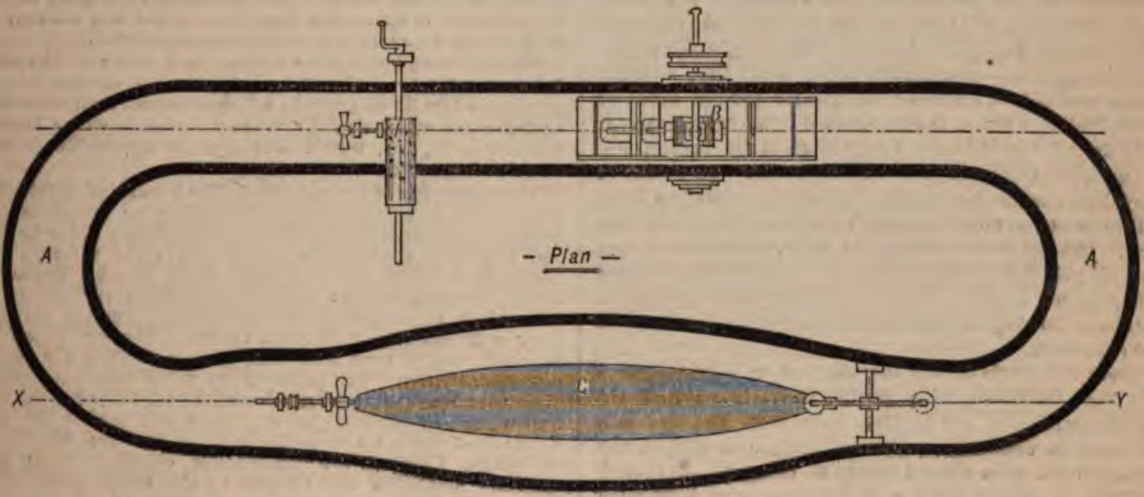
Mr. Richardson's arrangement is in the form of a double tank with semi-circular ends, in which the water is set in uniform motion and kept at that motion by a broad-bladed revolving paddle, which must be kept at a constant speed.

The hull and propeller is then made a fixture in the tank, the principle being used that results may be estimated just the same, whether the water moves relatively to the vessel or the ship moves relatively to the water. The convenience of the former method is obvious.

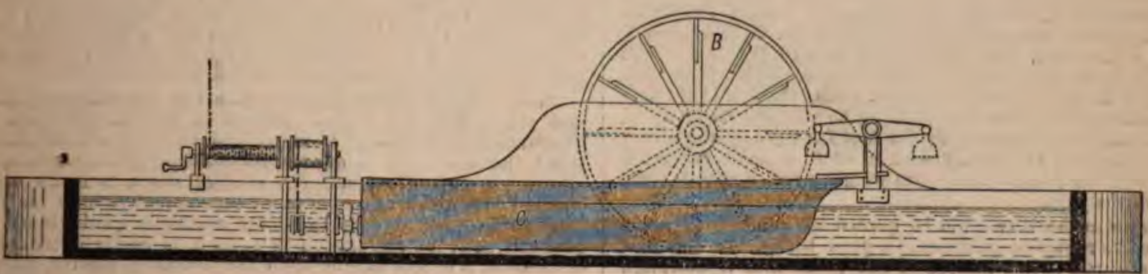
To test first the resistance of any hull at a given speed. The water is first made to revolve at the required speed by the large paddle, the speed being registered by the little indicator, shown in a separate illustration. This indicator revolves with the speed of the current and has a crank arm and indicating pencil attached to it, which registers the speed of the steam accurately. When the required speed has been properly adjusted, the hull is attached at its bow end to the vertical arm of a fixed T lever which pivots at the cross of the T. A weight may then be hung on the arm overhanging the hull, until the pull on the hull is just balanced. This is also the exact measure of the thrust on the propeller. The propeller shaft runs in fixed guides with about an inch of horizontal motion, and is rotated by a drum from overhead. The end of the hull is fitted with a bearing plate to rest on the propeller shaft, so that if the weight from the T lever over the hull be removed the hull rests back upon the propeller with the full thrust produced by the water. The propeller may be now rotated until it lifts the vessel against the stream, which would exactly indicate the speed of propeller required to drive the hull at the indicated speed of the current.

Any methods of driving the propeller and paddle may be used that may be convenient, and experiments can be made as to effects of tide, head wind, or stern wind, by weighting the T on either of its opposite ends. We think this apparatus highly ingenious and likely to prove extremely useful in the hands of marine engine manufacturers.

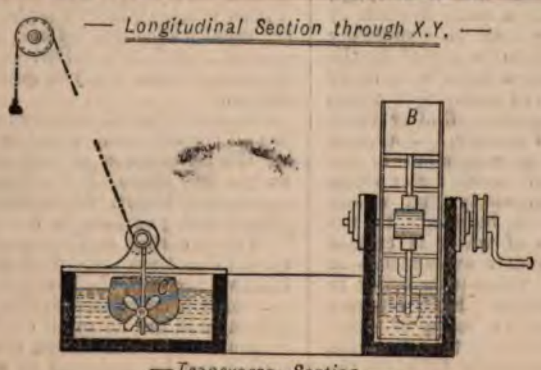
Richardson's Screw-Propeller Testing Apparatus.



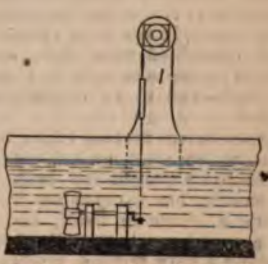
— Plan —



— Longitudinal Section through X.Y. —



—Transverse Section —



— Section Shewing Indicator —
— Slightly Enlarged —

WATER TUBE BOILER.

(DONALDSON'S PATENT.)

IT is well-known that one of the gravest and most important questions relating to steamships' Propulsion and the economic working of steamship companies, &c., hinges itself to a very great extent upon the improvement of the marine boiler. The existing type of marine boiler is quite in the rear of the modern compound engine, simply owing to the fact that while ample attention has been given to the engine and the theory of expansion, the boiler or the fundamental root of the whole economy has been ignored, being hitherto neglected by constructive engineers in general, on the supposition that anything would do for a boiler, and that the designing of such could safely be left to anyone who could put the plates together. However, it is not so, as the present everyday requirements are beginning to show. The engineering profession are at last becoming keenly alive to all this, and the result has been of late, a series of designs for various kinds of boilers, including a few of the water-tube type; which type if perfectly designed would have everything in its favour, and would quickly supersede all others in the questions of economy, lightness, and strength. These latter designs have been all more or less efficient, but also in many respects totally deficient. But at the same time the experience thus gained has been all pointing in the direction of needful requirements and consequent improvements. Each successive patent in water-tube boilers superseding its predecessor in value as to its general efficiency.

One great drawback to the introduction of new boilers is the fact that the shipowning public, through want of the requisite knowledge of the matter, have been and are still afraid to meddle with such a supposed dangerous subject, and so will rather go on in the old groove of using an old though known type of boiler than risk introducing a novelty of which at least they have a very faint notion regarding its trustworthiness and safety, to their own detriment and the loss of thousands of pounds annually. This has unfortunately been accelerated by a few disastrous attempts of some of the pioneers in this direction.

The water-tube boiler in various phases has been before the public for somewhere about ten years, and during that time though very little advancement has been made in introducing it into steamships, the time thus apparently lost will eventually be of great value to the successful boiler that may be designed to suit the public point of faith, which all this time and labour expended has been tending to educate them up to, and the competition ensured by the first far-sighted shipowner to take it up will eventually lead to such a boiler becoming general, and the present cumbrous weighty fuel waster become a thing of the past.

Numerous authorities could be quoted all tending to prove what are the requisite qualities of a good boiler. In the first place to ensure a proper mixing of the gases and a thorough combustion of the fuel, a boiler must have a large fire-box or combustion chamber, so that the gases may be completely ignited before coming in close contact to be cooled by the plates of the boiler. In the ordinary marine boiler with small contracted flues, thorough combustion can never take place, the greater part of the gaseous products passing off after being partially cooled, in the form of smoke. Secondly, the amount of water contained must bear a certain proportion to the quantity of steam to be raised—the less water the faster steam can be had—but to be consistent with safety and steady practical generation of steam, a limit must be fixed. In the present cylindrical marine boiler a mass of water is carried which is worse than useless, as it hinders evaporation in proportion to its weight and bulk. The water-tube boiler in this particular has everything in its favour. Each separate tube being a boiler in itself, and the tubes being of small diameter, are of great strength although of very thin material, and offering a very trifling medium interposing between the water and flame. Most of the preceding water-tube boilers have had their tubes too long in proportion to their diameter, with the consequent result that steam was generated faster than water could be supplied, resulting in the bareing and burning of the tube, and in some cases explosion.

The circulation to be good must be natural and free—no bends or tortuous passages. Ample steam space provided and sufficient surface of water. An insufficient surface retards the evaporation materially. The tubes should not be too long and should be easy of access for cleaning, examination, or removal when required. The boiler should be light in weight, and as small as possible, to save valuable space in the vessel; simple in construction, portable and easily put together in their manufacture. In all these details the water-tube boiler has the advantage. It is lighter, less bulky, a better steam generator, a more economical consumer of fuel, a safer boiler, and costs less than the present antiquated and cumbrous marine boiler. All the previous disastrous failures with water-tube boilers can easily be explained away, simply because nearly all that has been taught on the matter since the introduction of steam has been ignored, and the natural laws of heat and water been overlooked and neglected.

The appended illustration represents a boiler of the water-tube class lately patented, to which most of the foregoing principles laid down apply in a direct manner. This particular modification was designed expressly for use in steam launches, torpedo boats, &c., but is also equally applicable to steam vessels of any size.

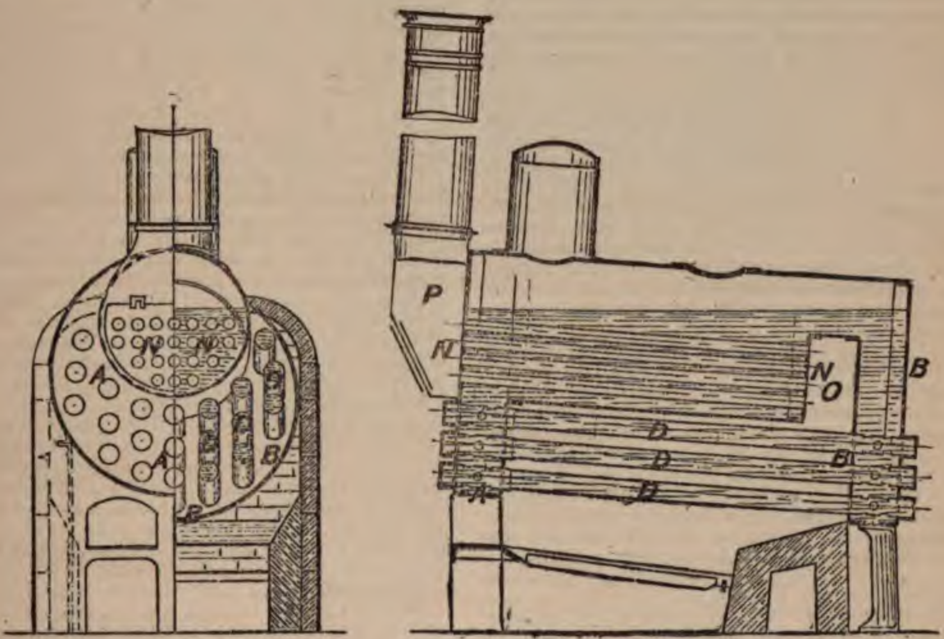
In explanation of the cut, the boiler consists of a cylindrical shell, having attached at each end large eccentric boxes, projecting downwards and forming the water boxes to which are fixed the water-tubes which pass right through longitudinally in the direction of the boiler's length. These tubes are in one piece and are fitted into the plates with conical nuts in such a manner that the greater the pressure the tighter they will become. The ends of the tubes are closed with screwed gas-pipe caps, admitting of easy facility for cleaning and examination. The parts of the tubes that pass through the water boxes are perforated with 2 inch holes for the steam and water to pass through. A piece is cut out of the cylindrical shell of the boiler at the back of the fire box, on the underside, forming the combustion chamber, from which ordinary fire-tubes are carried to the front plate of the boiler. The boiler is thus a combination of the water-tube and fire tube systems. The whole is supported and carried on iron framework, which is built up and lined with fire bricks, allowing of a large capacity of fire box.

A B represent the water boxes, O combustion chamber, D water-tubes, N fire-tubes, and P the uptake. In the figures representing the details of the tubes, D represents the tubes, E screwed cap, F G the perforations, *f g* conical nuts, *f' g'* screwed copper nuts formed with a lip, into which is inserted a steel ferrule, *h i* expanding the lip outwards against the plate in the same manner as an ordinary expanded tube.

There are various other arrangements of this boiler for land and other purposes, but at present it will be sufficient to illustrate this one only. It is claimed that the advantages of this boiler are that it affords portability, greater strength, allows for expansion, occupies smaller space, is much more efficient as a steam raiser, is more economical in coal (as the large furnace affords free space for complete combustion), is perfectly safe, the circulation is certain, is easily overhauled or cleaned, is of less weight than the ordinary marine boiler, is more efficient, more simple, less forced and less costly than the usual water-tube boilers, and being a combination of the present and future boiler, or a medium between theory and practice, is more likely to gain faith with steam users and ship owners.

It has all the advantages of the present marine boiler, it has all the advantages of the present water-tube boiler, and all the advantages of the locomotive furnace, without the weight and waste of the former or the uncertainty of the water-tube boiler, while the arrangement enables a very large heating surface to be obtained. It has been admitted that the heating surface of a water-tube is about six times more value than an ordinary fire-tube, still without taking this into account, the heating surface in relation to the size of the boiler is enormous—being about double that of the class generally in use for small craft, and by simply increasing the diameter of the end boxes, the number of tubes and heating surface can be increased in a manner speaking, indefinitely. It is expected to give a further account of some trials of this boiler when they have been sufficiently matured for publication.

WATER-TUBE BOILER.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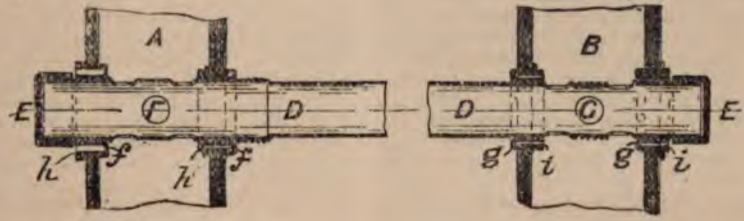
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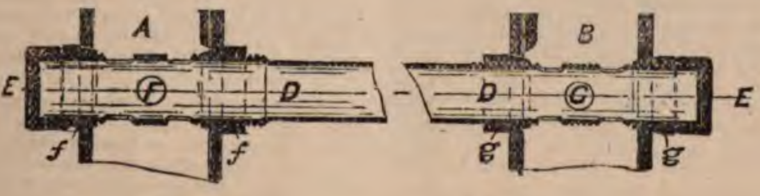
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ON THE USE OF STEEL IN NAVAL CONSTRUCTION.

Discussion on Mr. Barnaby's Paper.

[*Continued from Page* 58.]

MR. SNELUS next protested against separating the chemical question from the mechanical in questions of this kind.

Mr. Carbutt, of Leeds, made a few remarks on Government control, and Sir John Alleyne referred to a series of tests made last year at the Butterley Company's Works on the rigidity of iron and steel beams, in which he said it was shown that mild steel had only a slight advantage over really good rolled iron, especially when it was borne in mind that steel lost more by welding at the beam arm than iron did.

Mr. Spencer uttered a wail over the approaching death of his old friend iron, which he would say a good word for to the last, and although it required much audacity to do so in these days.

Dr. Siemens followed and said, he could not be entirely silent when a discussion of this kind took place. With regard to Mr. Adamson's paper, he would like to say a few words. He was glad to see that Mr. Adamson had arrived at the conclusion to which he (Dr. Siemens) had sometimes given expression—that in rivetting of steel plates you should use steel rivets, and you should put these rivets as closely together as you conveniently can. He was glad to see that Mr. Adamson had by his investigation brought this matter so clearly to light, but it was a thing that had often come before him (Dr. Siemens) in dealing with those very subjects which had been alluded to by Mr. Parker and others, the mysterious failures which occasionally have occurred. Now, it so happened that the one failure to which Mr. Parker alluded to came before him at the time, and the very nature of the failure proved, he thought, the cause which is hidden below the surface; but it was not beyond our ken to unravel. If a long cylinder of steel is flanged, and if this flange is drawn mechanically to fit a larger surface, or if a cylindrical top is intended to fit into a flanged neck and the tube is too small, and if, being flanged all round, or drilled, it is intended to be brought up to a larger diameter, it stands to reason that a great strain is to be put upon the metal between the rivet holes and the outside. Now suppose that this strain—the compressive strain which is thrown upon the edge of this place—must be borne by some metal which is thrown into great tensile strain, and that will be the metal immediately behind the line of holes, the result is then in any one of those holes, if there is a slight discontinuation of the even surface, a tearing will begin. Now, it was said that this metal, which ought to stretch 25 per cent. before tearing, should not have torn under those circumstances, because we can find that it was not stretched at all, but in arguing thus, these gentlemen overlooked the fact that in tearing a material you do not extend. A tear means applying the whole of the force available upon absolutely one point of the metal, and on that point there might be a stretch of 50 per cent; but it is infinitesimal. It may tear one point and the next point, but in this extreme case the failure may be attributed to the tearing action which is generally set up at rivet holes; thus, then, these holes take more than their due proportion of strain. He knew of another instance where the failure took place in the testing bar; it was intended to test the strength of a rivet joint; but in fastening the piece it was held by two large rivets followed by a small rivet. Metal with high elasticity, such as mild steel, will throw a great strain upon that support which is most forward because the supports which are backward cannot come into bearing condition till the forward point has taken the principal strain, and whenever that strain exceeds certain limits, tearing action will set in at that point where the continuity of the metal is broken such as at the rivet hole. One of the chief advantages that has been found in favour of drilling over punching is, that the drill makes a smoother hole, and there is a less inducement for a tear to set up. He believed that was really the chief difference, and as it has been said in this discussion, and said by Mr. Barnaby in his paper, mild steel should not require either the particular attention and expense due to the drilling, nor does it require annealing. These failures are generally attributed to a difference in the treatment.

Mr. Head said Mr. Spencer had observed that it required something akin to audacity for any manufacturer of iron to advocate iron before the present meeting in opposition to steel. He thought to some extent the observation was correct. Certain it is that during the last three meetings of the Institute any outsider would infer that not a word was to be said in favour of iron, and that steel, or the merits of steel, were the only things either that would be listened to or that could find any advocates. Now he questioned whether either in the interests of iron or steel it was desirable that all the talking should be on one side. If nothing was to be said in favour of iron, by all means let nothing be said; but if anything could be said, he thought all the members would wish it should come out. He was one of a firm of manufacturers of iron ship and boiler plates on a large scale; and during two years they kept an exact account of the number of plates returned as faulty, and reduced them to a percentage of the total number sent out. He believed one-fourth of the whole quantity produced were either test plates for shipbuilding or boiler plates. A great many were used for flange plates and Galloway tubes. It should be remembered that some of them were severely tested, keel plates being bent at right angles. Taking the rejections of keel plates bent at right angles across the grain, taking also the rejections for Galloway tubes and flanges during the two years, the total rejections in iron plates numbered 1 in 250. In shipbuilding the test put on iron in the course of construction was probably more severe than the ship had to stand afterwards, except in cases of touching of ground or in collisions; and when they considered what the plates had to stand, he thought the description given of iron was not a fair one. As to comparing steel with iron ships in respect of strength, Mr. Barnaby almost complained that steel could not be expected to supersede iron so rapidly as might be desired, because iron ships would not wear out quickly enough. Iron in ships seemed to stand very well; barring touching the ground, bumping the rocks, or collisions, they seemed good enough, and, of course, steel ships in cases of collision are very little better than iron ones. At the present time, too, iron ship plates are only about half the price of steel plates, and hence only 0·75 per cent. of the ships built last year were steel. With regard to boiler purposes, no doubt in many cases steel is much better—for such purposes, for instance, as flanging; but iron could be made to form Galloway tubes for £2 a ton less than steel. There would be a period when the public would want both iron and steel, and it was a question with him whether iron would be altogether superseded at all; but if it were so, he thought they would find the manufacturers ready to adapt themselves to whatever the public demand might be. If there were gentlemen present who were inclined to say that he, as an iron manufacturer, was biassed in his views, he was not prepared to say that he was not; but he asked whether those gentlemen who advocated steel were altogether unbiassed, in urging the adoption of that material. If they were only to get questions of scientific interest discussed by men completely unbiassed, he was afraid they would have no discussion at all.

Mr. I. L. Bell said it was quite clear that the relative merits of iron and steel need not be determined by the Iron and Steel Institute. The impediment to the more rapid introduction of steel for shipbuilding had, he apprehended, been the great difference in the price of the material. In Mr. Barnaby's paper there was rather too much of an attempt made to compare Bessemer steel with Martin-Siemens steel. He did not pretend for a moment that that was not a very appropriate subject for discussion, but he thought that before entering into such a discussion they ought to be furnished with the means of forming an opinion. In the absence of any information relative to the chemical composition of the two kinds of steel, they would not be able to pursue that inquiry as fully as might be desired. Of course in making a comparison between two systems of operation it would be necessary to know if the quality of the pig iron was in each case the same, in order that they might judge whether the conditions and causes attending decarbonisation of pig iron was more complete or less complete in the Bessemer than in the Martin-Siemens process. He thought that they might take it for granted that most excellent steel could be produced by either process.

Mr. Samuelson said, bearing in mind the money that had been spent for this purpose, and also that the Government were probably the most extensive shipbuilders in the world, he thought they might fairly make an appeal to them that they should assist the private shipbuilders of this country, and those who were to supply them with the material with which those ships were to be built, with some more data in the same direction, but of a more extensive nature than those presented to them by Mr. Barnaby, in his paper. He therefore called upon Mr. Barnaby, and through him on the Government, to do their fair share in the business of ascertaining as precisely as possible the conditions under which steel of various qualities, manufactured in various works, might be applied to the various purposes of shipbuilding for which they were designed.

Mr. White said the Admiralty had left the manufacturers the producing of the material which would satisfy their tests, made both in the open hearth and Bessemer process in the construction of ships, and they had used both these processes simultaneously. In some ships one quality of material is used and in others some other qualities are used. Mr. Barnaby said that his object in putting the difficulty before the Institute was to obtain material which should give them no such difficulties. He did not say that those difficulties represented our average practice or that they were of constant occurrence, but that they did occur. He might say that in the two first steel ships, the Iris and the Mercury, which were built at Pembroke with open-hearth steel—there were a great many hundred tons of frames and there were only two breakages in the bending of the angle bars contained in those ships. Then, in the ships at Chatham, where the Bessemer make of steel had been used for the angle bars, although these breakages had been very singular in their character, it must not be presumed that they had been so numerous at Pembroke, perhaps they had a better workshop, but in all other respects the Chatham yard was identical in temperature, the conditions of working, and the supervision. Out of the Pembroke yard they had turned some thousand frames, and there were only two or three breakages of the Bessemer steel. These were facts which Mr. Barnaby was anxious to have placed before them. As to the actual practice of private shipbuilders in the matter of steel shipbuilding, he should like to ask a question. He was aware of the regulations which Lloyd's surveyors had issued, and they were identical with those issued by the Government. He would ask whether the annealing was generally practised after any piece of the structure had been worked hot? In the Government yards they did that if the frame was bent. Then he would ask what inspection was there which would enable any percentage to be stated for the breakages which actually take place in the bending of steel plates in a private ship-yard? In the dockyard that was accurately ascertained. Then comes whether the tests which determined pretty absolutely the quality of the material that was mild steel, at 25 tons to 30 tons to the inch, whether those tests were actually carried out, and was there any guarantee that in the steel ships built in the mercantile yards the quality was that which was required by the regulations?

Mr. Price Williams said he had been greatly impressed by the insufficiency of the tabulated results which were presented by his friend Mr. Barnaby, and he felt that he should have been untrue to himself and his own instincts if he did not draw attention to the sufficient data supplied. He had carried out experiments as to the mysterious behaviour of rails by himself at great expense, and in conjunction with Mr. Riley and Mr. Kirkcaldy, and the conclusion they had come to was that they wanted particular circumstances of the manufactory thoroughly well known. They ought to know the conditions of the atmosphere floating over these rails; and he might mention that of two rails where the chemical analysis was the same, there was the startling difference that one rail in a long period had become entirely worn away, and the other was almost as good as it was when it was put down. The conclusion they came to on that was that in the borings of the one they were very hard, and showed that the process of chilling had occurred in that particular rail, and it was not present in the other. There were great changes in the mechanical handling of those rails, and this pointed to the unfair representation of the results obtained by what was called the open-hearth and the converter system, of which they had not sufficient data.

Mr. John, one of the surveyors of Lloyd's having had a great deal to do with the introduction of steel for mercantile purposes, could not fail to express his thanks for the praise bestowed upon Lloyd's, and the more so as they were more accustomed to hear grumbling than praise. He went around with his colleagues, by instruction of the Committee, and visited many of the steel manufactories, and they saw ships made from Bessemer and Siemens-Martin steel, and they became practically convinced by both these processes that they could by careful management secure uniformity, and they felt that there was not ground sufficient to make a distinction between them. With reference to the steel angles, he had tested a number of angles for shipbuilding purposes, made of Bessemer steel in the Cleveland district. Those angles were 5½ to 3½in., and they were tested in every conceivable way. They were opened out flat, they were doubled up, and they applied the temperature test and the tensile test, and in every case with perfect success. He had seen the material tested in other places, and there was the fact of a large quantity of angles, possessing practical uniformity and quality, and any amount of ductility, and he could not help feeling that those angles, if properly dealt with in a shipbuilding yard would turn out not only as good, but better than iron. Then, as to the comparative rigidity of steel and iron, that was a point which had not been so much looked into as ductility and the tensile strain. He got from a shipyard a piece of iron angle 5½ in. by 3½ by $\frac{10}{16}$, 6ft. long, and such as was of use in shipyards. They used two supports, 4ft. apart, and made careful tests by means of a set of levers at the middle to compare the rigidity. He inspected two samples, and found from the result something very different from what he had expected. The steel was 25 per cent. lighter than the iron, and it stood the test better. The iron took a permanent set before the steel did, and after that the steel rapidly became better than the iron. There was one point he would speak of in Mr. Barnaby's paper; if it was not convenient to anneal the whole of the plate or angle in working, it might be partially annealed; but he should like Mr. Barnaby to explain, from his large experience of steel, whether partial annealing was satisfactory. Whether it was satisfactory if they fired an angle at one end or both ends, whether it was annealed in proper sense to have the half of it annealed and then turn the other and anneal it. That was a point which affected the working of steel very materially. They knew that they could do it with iron, but with many things they could not; for instance, it would have a very bad effect first baking a pie at one end, and he did not think they should conduct annealing of steel in that way either. There was one other point that he did not think had been cleared up—that was why it was that this steel cracked sometimes mysteriously. Dr. Siemens had explained it to some extent by saying that it was owing to the extreme ductility of the material that it sooner set to a partial action; but very ductile iron did not fly in this way, so that he thought there was something more in it than they were aware of as yet.

The President then called upon the gentleman who read the paper under discussion to reply.

Mr. Barnaby remarked that he had no reason to complain of the treatment he had received from the meeting. He was pained to hear from his friend Mr. Price Williams what seemed to imply that he had not taken sufficient care and pains as to the facts he had put before them. He had done nothing other than to summarise a statement, for the convenience of the members present, as to the tests, and the full statement he now produced; and as it was large, he thought it showed a certain amount of painstaking in comparing the quality of material. He also wished to say that while their friends in the mercantile shipbuilding trade did allow steel to lie buried for ten years, as was shown from the statements made on Wednesday by Mr. Bessemer, they allowed steel to remain buried for ten years while the Admiralty were using it continually. The Admiralty never ceased to use steel for ships of war for fifteen years, so that he had had fifteen years' experience of steel from the converter, and four years of the open-hearth; and it was with that experience that he stood before them and put before them the facts they had heard. Mr. Bell asked why they did not give the chemical tests. Well, as to the plates, they were at Chatham Dockyard, and if any one had sufficient interest in them, he would be admitted to take specimens, and to test them for himself; if, however, they preferred the Admiralty to become chemists, they might become steel makers as well. As to the bars that he had given an account of, what he knew about them was that every single bar was tested before it left the works of the manufacturers: the result of that test was carefully recorded, and when a fracture happened, the manufacturer himself took specimens of the bar in question, and then applied his own chemical tests, but found no difference. Not only so, but specimens were cut off close to the fracture by the testers for the Admiralty and they could find no difference, which showed that the materials complied with the conditions laid down by the Admiralty, and that they could not detect the cause of the fracture that they did not like. Mr. Bell thought he—Mr. Barnaby—did not point out the difference between the two makers of steel. Gentlemen perhaps felt some force in the remark; but he thought that when he—Mr. Barnaby—came before them they should know perfectly well that he had no interest in one way or other. He did not think that every one in that meeting was in that position, and while perhaps the manufacturers from motives of delicacy would not say all they wished, it was his interest, if there was any advantages in steel, to let the shipbuilders know it. He had been urged by officers at the dockyards to use nothing but Siemens steel. There was a certain advantage, as it appeared to him, in favour of that which was made by a slower process, but the Admiralty continued to use two kinds of steel in their dockyard, but with this important condition, that when a plate or bar was sent for use by the Admiralty a piece was cut off to test it. If any shipbuilder in England could honestly say he always did that, let him stand up and say that all this precaution was moonshine. What he was afraid of was that they did not get in steel what they got in iron ships built of materials not tested. The result of that practice was that iron in many cases went into ships that should never have gone in, and shipbuilders were pained by hearing the very lowest class of iron spoken of as ship plates. The chief surveyor for Lloyd's Register took him to task on the subject, but those gentlemen had known perfectly well what sort of iron had been going into ships, and they had allowed this new material to sleep for ten years. The gentleman who spoke on Wednesday was Lloyd's surveyor during those ten years; why, when the Admiralty were going on continually using Bessemer steel, were they not using steel? What he specially wished to say was this, that there was a gap of ten years, during which the mercantile shipbuilders were not using steel; whose fault was that? He believed it lay with the steelmakers themselves, for they, when complaints were made, chose to say, "Well, now you are an interested person, and should not say that; you did not raise your voice against steel; either you do not understand it, or did not know how to use it." He had not spoken in that way to them, but if in their minds the things he did were due to ignorance, he replied that if they were ignorant and careless in any of the Royal Dockyards they would not find wisdom and care in the dockyards of the kingdom; at any rate they would be very few. He was afraid that this sort of thing was going on—and he would be grieved at it if it was—that Lloyd's surveyors were going to allow the shipbuilders of this country to go madly in for the use of steel because it is steel, without insisting on proper tests for it. Their regulations should provide that every plate that was so used should have a brand, which would signify that pieces had been cut off every plate, and that thus each one had been tested and had satisfied the test. He was told that Lloyd's people were going to relax their regulations, and were not going to insist upon having a piece of every plate tested. If that happened, he verily believed they would have another death and burial of steel in shipbuilding. If they did not take care and insist on having every plate and bar stamped to signify that they knew well what the plate or bar is, they would have a reaction against the use of steel. He would regret that immensely. He stood there as the advocate of steel; and if it went back once more people would say;—There is that fellow at the Admiralty who has built ships of that rubbishy stuff that everybody now denounces. He wanted steel to be used, and all proper precautions taken to test it.

Messrs. Adamson and Maynard having also replied, the President then proposed a vote of thanks to the writers of the papers that had been discussed, which was carried unanimously.

TESTING OF COMPOUND ARMOUR AT PORTSMOUTH.

THE compound steel and iron armour intended for the turrets of Her Majesty's ship Inflexible was tested on board the Nettle, target-ship, at Portsmouth, on Saturday last week. Hitherto all trials of steel-faced armour-plates have been for merely experimental purposes; but on this occasion the plate subjected to the crucial ordeal of being fired at at short range, was one of a series which had been expressly manufactured by Messrs. Cammell, of the Cyclops Works, Sheffield, for the defence of a ship of war. And as the Inflexible is the first vessel which will have the protection of compound armour, the testing drew together a number of officers and gentlemen who are profoundly interested in the gun *versus* armour problem, among whom may be mentioned Vice-Admiral Sir Houston Stewart, Controller of the Navy, Rear-Admiral Hamilton, Director of Naval Ordnance, Mr. N. Barnaby, Director of Naval Construction, Colonel Inglis, R.E., Captain M‘Clintock and Captain Cyprian Brydge, of the heavy gun committee; Mr. George Rendle, of the Elswick Ordnance Company; Le Comte Oscar Cassini, Austrian Naval Attaché; Captain Alfred Gervais, French Naval Attaché; Mr. W. B. Robinson, Chief Constructor at Portsmouth, &c. The firm of the manufacturers was represented by Mr. George Wilson, chairman of directors, and the two Messrs. Cammell, and the trial was conducted by Captain Herbert of the Excellent gunnery ship.

It was originally intended that the turret walls of the Inflexible should consist of 18 inches of solid iron armour, 18 inches of teak backing, and an inner iron skin of 1 inch in two equal thicknesses. With the adoption of steel, however, the same weight of metal will not be required, and it is therefore now intended to construct the walls of 16 inches of armour and 18 inches of backing, the armour being in two thicknesses—namely, an outer ring of 9 inch compound armour and an inner ring of 7 inch iron plating, the whole being bolted together from the inside with steel bolts fitted with the new rubber washers. Hitherto thick backing has been used for the purpose of distributing the blow, deadening the vibrations, and protecting the fastenings. Apart from these considerations, however, Mr. Barnaby attaches a distinct advantage to depth of target. Accepting the statement that the force residing in a projectile may be estimated by the average powder-pressure in the gun, multiplied by the distance through which it has been active, and assuming the projectile to be a hard substance and that its motion is to be arrested by hard armour, it follows that the total energy would have to be consumed within an indefinitely short space of time, during which the force of impact exerted would be infinite in amount. In other words, either the projectile or the armour it strikes, or both of them must be broken up, but if the target posesses a certain amount of ductility or penetrability, it will be penetrated until the force residing in the projectile be absorbed. Hence as Mr. Barnaby shows, if the target offers a certain amount of resistance continuously after perforation is commenced, and before the skin of the ship is reached, the energy is taken out of the projectile by a resistance comparable in amount with the original powder-pressure. The target may be of such depth as to need only a continuous resistance, equal to or even less than this original pressure. But to resist the penetration of projectiles by the absorption of energy alone would require protection of enormous depth and weight—so heavy, indeed, as to become burdensome to the ship. It was consequently deemed expedient to make the outer surface as hard as possible, so as to resist the penetration of the point of chilled shot, and thus to cause it to break upon impact. Sir Joseph Whitworth and other manufacturers have succeeded in producing a steel of so hard a nature that it has resisted all attempts to penetrate it, and against the face of which the Palliser chilled projectiles have actually plastered themselves. But while it was impossible for a shot to get through steel armour, it was demonstrated at every experiment that the protection which broke up the shot was itself starred and cracked by the blows of guns of comparatively light natures, and that it would eventually drop from the sides of the ship and leave it wholly defenceless. Only last month experiments on a large scale were made by the Italian Government at Spezzia, on four solid steel plates, with the result that they were all completely destroyed. Under these circumstances many were led to prefer iron armour of the usual kind, which, though it is easily perforated, does not fissure, to the hard steel armour which, though it breaks up the shot, is itself readily broken up. Such was the state of the matter when Messrs. Cammell strongly declared themselves in favour of compound armour, that is to say, iron plates faced with steel. This was no new device, for as far back as 1867 some compound armour-plates were manufactured by the firm and experimented upon both at Shoebury and at Zegel in Prussia, with marked diminution of penetration as compared with solid iron plates. The object of welding the steel and iron together is not, of course, to prevent the plate from cracking, but to prevent the fissures from extending through to the skin plating in the rear of the armour, and as the ductility of iron is superior to that of steel, it was supposed that the welding of the plates would also hold the outer strake of steel in its place after being broken, and so prevent its falling off the ship. The first trials of the compound armour, however, showed that the welding of the two metals was imperfect, and that they separated under the impact of shot. This defect has since been remedied by a process patented by Mr. Wilson, jun., and adopted by Messrs. Cammell. The iron armour is first heated in a furnace—of which it forms the bed, to a good red heat, and when in this condition it is conveyed to other furnaces, the molten steel from which is allowed to flow upon the surface of the iron to the required depth, and as the temperature of the fluid steel is much in excess of the welding temperature of the iron, the surface of the latter becomes partly fused by the overlaying liquid metal, and a complete weld is thus produced between the iron and the steel, a third being formed between the two by a portion of the carbon of the steel running into the iron. By this method the two plates are inseparably united by a zone of semi-steel, which has been found to vary in thickness from an eighth to more than a quater of an inch.

The practical advantages of the compound armour over armour formed wholly either of steel or iron have been satisfactorily demonstrated, and the Constructive Department naturally reluctant to adopt crude innovations, have at length, after a series of experiments at Shoebury and Portsmouth, been led to adopt the new protection for the turrets of the Inflexible. A plate manufactured by Messrs. Cammell, and composed of 3½ inches of hard steel upon 5½ inches of iron, resisted five rounds from the 9 inch gun on board the Nettle, completely breaking up the projectiles at 30 feet, and at Shoebury a blow which has perforated a 12 inch iron plate has been delivered three times at a 10 inch compound plate without any of the projectiles getting through. At the recent Paris Exhibition, too, both Messrs. Brown and Messrs. Cammell exhibited the comparative results of shots fired at steel and compound plates. The armour was in each instance 9 inches thick, and was tested by a 7 inch gun and a Palliser chilled shot at 70 feet range. The Brown iron plate was indented 8 inches without cracking with a charge of 25 lbs of powder, the Cammell plate being perforated, also without cracking, with a charge of 5 lbs heavier. On the other hand the compound plate manufactured by the first firm, composed of equal thicknesses of steel and iron, was only indented 4⅜ inches without cracking, while the Cammell's plate which was 5 inches of steel and 4 inches of iron, was only indented 3·12 inches. In this latter case the steel part opened from the hole to the edge ⅛ inch, but the crack failed to go through the iron.

The trials at Portsmouth on Saturday were in no sense experiments, but were conducted on the nut dealer's principle of cracking and trying before buying. With regard to iron armour, it is the invariable rule with the Admiralty before accepting plates from the manufacturers to select one at random from a batch, and submit it to a practical test under fire on board the Nettle at Portsmouth. For the purposes of the trial the sample plate is bolted against a strongly secured wood backing, which is carefully "dubbed" to fit the shape of the iron. It is then fired at from a short range, 30 feet, the shots being placed as closely together as possible, the freedom or comparative freedom of the intervening ridges from cracks being held to determine the quality, not only of the plate itself, but of the whole batch from which it has been selected. Should it pass the ordeal as A1 or A2 the plates are accepted, but if found to be of a lower order of merit they are always rejected. The customary tests consist of four shots, but in the case of some plates manufactured by Messrs. Cammell for the turret ship Ajax and Agamemnon, as many as nine rounds were fired at the sample. Steel armour, however, is an innovation, and its manufacture in respect of uniformity cannot be relied upon to the same extent as iron. It has been found by previous experiments, both at Portsmouth and elsewhere and with steel of all degrees of quality, from hard to mild, and manufactured by all known processes that its behaviour under apparently the same conditions is erratic and mysterious, fissures and hair cracks frequently manifesting themselves at remote distances from the spot struck. It also frequently happens that the work of demoralisation goes on for considerable periods after impact owing either to the continued disarrangement of the molecules or to the effect of cooling, or to some other undefinable cause. The facts being as stated, and the difficulties of manufacture being so much more in the case of steel than of iron—overheating, for instance, being destructive of the endurance of a plate, while sudden cooling produces oxydisation and consequent deterioration—the Admiralty have declined to accept the endurance of a test plate as a gurantee of the quality and endurance of a number of plates, but have insisted—and wisely so—that a portion of each compound plate shall be independently submitted to a crucial ordeal. The conditions prescribed for the turret armour of the Inflexible are that a piece about 6 ft. long cut off the bent plate, and secured to backing, shall neither be perforated nor cracked through by a shot which would perforate a similar plate of iron, and that if the edges of the test pieces are supported by a frame in addition, no one of three such shots planted at 2 feet intervals shall get through.

The test piece that was fired at on board the Nettle on Saturday measured 8 feet 4 inches in height by 6 feet broad, and had been cut from a plate the original dimensions of which were 22 feet in length by 8 feet, or sufficient to cover the whole height of the Inflexible's turrets from the deck without through butts or joints. This was the important advantage sought by Mr. Barnaby in protecting the turrets by two thicknesses of plating instead of one. Experiments at Shoebury in 1871 had proved that the resistance offered by a target composed of 14 inches of solid armour, and by a second target composed of armour of two thicknesses of 8 inches and 6 inches, was practically the same. Reducing the depth of the armour, however, enabled larger plates to be manufactured, and taking into consideration the fact that the double-plate system admitted of the employment in turrets of armour of a breadth equal to the height of the turret, that through joints could be dispensed with, that the bolting and securing of the structure were facilitated, and that the total resistance did not appear to be practically affected, Mr. Barnaby has been led to adopt in the Inflexible the recommendations of the experimental committee. The iron plate was originally 9 inches in thickness, upon which 5 inches of liquid steel, high in carbon, was poured, making a total of 14 inches. The compound plate thus formed was rolled down to 9 inches—viz., 3½ inches of steel upon 5½ inches of iron, which is its finished proportion, and bent to a radius of 16 feet 6 inches to adapt it to the cuvature of the turret. The test piece was fixed in a frame composed of four bars of wrought iron 8 inches thick and 2 feet wide, the bars being dovetailed into each other at the corners and bolted through at these parts to the bulkhead. The purpose of the frame was to give to the plate under test the lateral support which it would receive from the adjoining plates, when on the turrets or sides of a ship. Having been inserted and wedged into the frame, the test piece was fastened at each corner by a bolt, which was tapped into the iron forming the back of the plate to a depth of 2½ inches only so that the steel face of the plate was unbroken by bolt-holes. This will be the method adopted in fastening the plates on to the turret of the Inflexible. The bolts are of sub-carburised or very mild steel, one bolt being used for every 11 or 12 square feet of area of surface. In consequence of the unusual height of the plate, it had been necessary to increase the height of the bulkhead against which the target was fixed. the whole being supported by massive spauls and transomes.

The tests consisted of firing three shots against the centre of the plate, 2 feet apart, in the form of an equilateral triangle (⁎*⁎), at a range of 30 feet. The piece used on the occasion was a 12-ton 9 inch gun, the charge 50 lb. of (P. 2) powder, and the projectile a Palliser chilled shot weighing 250 lb., with gas check, and having a striking velocity of 1,406 feet per second. The first shot struck the target 2 feet 6 inches from the right edge and 4 feet 6 inches from the lower edge, and "splashed" upon the face of the plate where a large portion of it remained. No ripple was formed, and not a single radial crack was observed to have opened out. There was, however, a slight irregular crack seen around the impact. The shot was thoroughly broken up. The second shot which also splashed, struck 6½ inches nearer the right edge of the plate, and 23 inches below the first shot, measuring from centre to centre of impact. It opened a radial crack from the spot first hit to the right edge of the plate, and opened cracks from the place of second impact diagonally to the middle of bottom edge, and also towards, but not quite to the right edge. The bottom crack was found to be only 1 inch deep. There was again a circular hair fissure around the shot mark. The third and last shot, which likewise splashed and broke up, produced five lateral cracks to the left edge and nearly parallel to each other, and opened out a sixth running vertically from the first to the second shot mark. In no case did the cracks penetrate as far as the iron backing, neither did any of the shot suceed in getting through the steel surface. So localised, indeed, were the effects to the neighbourhood of the several impacts, that it was thought the plate would have withstood six more blows. At the termination of the official tests Mr. Wilson was warmly congratulated by the officers and gentlemen present on the success which had attended the trial, and upon the marvellous endurance which the compound armour had exhibited under an exceptionally severe test. These results will probably produce a revolution as regards the protection of ships of war, and fully justify the adventurous policy of the English Constructive Department in adopting compound armour in preference to armour composed wholly of steel.—*The Times.*

COCHRAN'S PATENT BOILER.

A GOOD and efficient generator of steam is a great desideratum, both on land and at sea, but perhaps most particularly so on the latter, where space is so limited and valuable on board ship, and where every pound of coal saved is a matter of such consideration. The chief type of boiler used on vessels, or even launches, is horizontal, and therefore to a very great extent weighty and liable to great alterations of surface, by the rolling or pitching of the vessel.

There are very few vertical boilers that are at all suited to rapid generation, freedom from repairs, and easy access for renewals. Where tubes are used, the direct contact of the flame with the tube-plate is most injurious to the tube, and is very apt to cause undue expansion and contraction, and thus to set up leakage. Nor in such forms of construction can the tubes be readily plugged or replaced, as the fire must be extinguished and the boiler even cooled down, before a man can attempt to repair, or even satisfactorily plug a tube end, in the fire-box of a boiler with horizontal fire-tubes, such as those of a portable or locomotive engine.

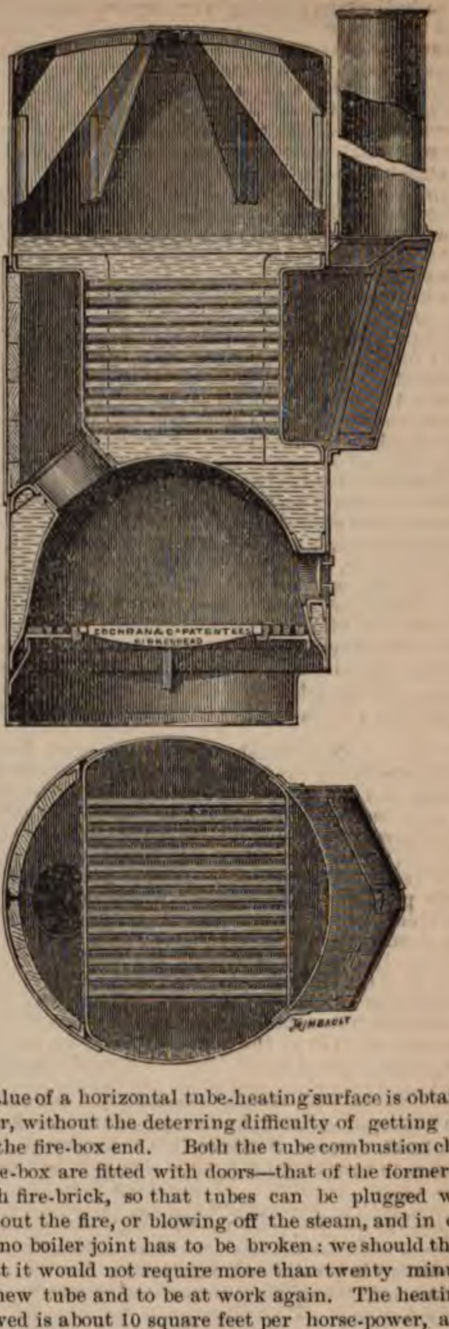
In vertical boilers there are two most distinct types that may generally be easily recognised. One is with vertical fire-tubes passing through both the water and the steam, and the other with horizontal or inclined water-tubes passing through the fire-box and general products of combustion.

Both of these forms of boiler are liable to grave disadvantages. In the case of the boiler with vertical tubes, part of these tubes are in the steam, and therefore very liable to over-heat. The expansion and contraction of such tubes, directly exposed to the heat of the flames, is also very great, and very liable to make either the top joint of the boiler or the bottom joints at the tube plate leak. And in addition to this, the vertical surface of the tubes, parallel to the issuing products of combustion are in the worst position for effective evaporation, and allow the heat to escape too readily and directly up the chimney. There is a likelihood also of a very considerable deposit of sediment on the most effective portion of the fire-box which is necessarily flat and encumbered with a considerable number of tubes.

In the case of the horizontal or inclined water-tubes, they invariably soot up in a few months, so as to almost entirely deaden the draught, and therefore the evaporation. Besides, the most grave defect of all pertaining to this form is, the fact that the upper shell of the boiler must be removed in order that the tubes may be drawn or renewed. This employment of an angle iron joint in the shell of the boiler, and the use of two dead-length joints—one on the angle iron, and the other at the top—is a most unsatisfactory arrangement, as these joints can only be made tight with difficulty, and are almost certain to leak after a few months' wear.

Messrs. Cochran and Co., of Birkenhead and Liverpool, have certainly succeeded in making a boiler which keeps clear entirely of the objections we have above outlined, and which is a first-rate evaporator, as will be seen from our illustration. Messrs. Cochran's heating arrangements first consist of a fire-box, or combustion chamber, which is dome-shaped, and from which the egress of the products of combustion is by a circular flue, issuing some distance below the crown. This form of fire-box has several advantages. From its shape it is very stong to resist compression, and no sediment will have any tendency to lie upon it. The hot gases will also collect in the crown, thus forming a combustion chamber, before passing up the branch flue.

After passing up this branch flue the hot gases collect into a second combustion chamber above; from this they pass through a large number of horizontal tubes across the boiler to a smoke-box on the other side, to which the chimney is attached. Thus all the value of a horizontal tube-heating surface is obtained in this boiler, without the deterring difficulty of getting at the tubes at the fire-box end. Both the tube combustion chamber and smoke-box are fitted with doors—that of the former being lined with fire-brick, so that tubes can be plugged without damping out the fire, or blowing off the steam, and in case of renewal no boiler joint has to be broken: we should therefore think that it would not require more than twenty minutes to put in a new tube and to be at work again. The heating surface allowed is about 10 square feet per horse-power, and we understand that this boiler has often evaporated over 10 lbs. of water per lb. of coal. This is an excellent result.



The boiler, as illustrated, has been supplied for donkey purposes to the s.s. Antwerp.

MANCHESTER AS A SEAPORT.—A meeting has been held for the purpose of considering further the proposal of Mr. Hamilton Fulton, for the improvement of the navigation from Manchester to the sea, so as to accommodate steamers of the largest class. It is estimated that an annual saving to the city of 6s. 6d. per ton upon 4,000,000 tons would accrue, amounting to £1,300,000 annually, which, if capitalised at twenty years' purchase, would reach to the large sum of £26,000,000, and after deducting £3,500,000, the estimated cost of the work, would leave a clear gain to Manchester of £22,500,000.

THE ROYAL AGRICULTURAL SHOW.

THIS show was characterized by one very striking peculiarity, and that was mud—mud such as is seldom seen or thought of, apart from ploughed fields, in the wettest weather. It was almost impossible to get about, and the attention required to pick one's way very largely diverted the observation from worthy exhibits.

As might have been expected, there was not much to interest "marine engineers," except in so far that all engineering is of so kindred a spirit that all departments are interesting to members of others.

Some very fine specimens of crank work was well worth the attention of all members of the profession. Clarke's Crank Compy. have plant suitable for bending cranks up to 12 inches in diameter. This class of crank has already been very largely adopted in ordinary horizontal engines, pumps, &c., and we would recommend this formation of crank to the marine profession. That crank is decidedly the strongest which has the fibres arranged longitudinally with the throw of the crank. The method of forging cranks in a solid piece, and with the throw cut out with setts or in a slotting machine, is inherently weak, as the fibres in such a crank are parallel with the main shaft, and thus lie across the arm of the throw, not longitudinally with it. Messrs. Clarke exhibit what is generally understood to be a forged crank, as above described, and such as is usually supplied to marine engineers. But this crank had the speciality of being first bent out of the round, so as to bring all the fibres longitudinally with the throw, and then forged out rectangular and shaped up bright. This is just the class of crank for marine engines.

The exhibits also of cast steel were well worthy the attention of our readers, as this material seems more and more likely to be largely adopted in general engineering construction. Messrs. John Spencer and Sons, of Newcastle-on-Tyne, and Hadfield's Steel Foundry Compy., of Sheffield, were exhibitors of this class of material, applied to gearing, crop-heads, cranks, paddle brackets, and a thousand and one useful purposes The value of cast steel for lightness, strength, and length of wear, cannot be too highly estimated, and as steel can now be produced as kind and tough as wrought iron, for working into plates, bars, &c., we should not be surprised in a few years' time to find steel, mild and cast, the only forms of iron employed for any purpose where maximum efficiency and lengthened wear is required.

A very large number and variety of pumps were exhibited, many of which were very applicable to bilge pumping or circulators for condensers. Messrs. J. and H. Gwynne, of Hammersmith, in particular, had a capital arrangement specially applicable to marine condensers. A centrifugal pump is driven by a small donkey engine, at a suitable speed to circulate water in a surface condenser, and to the engine is attached also an open plunger pump, which is connected direct to the hot well, or condenser. So that before the engine is started, the donkey pump may be set in motion, circulating the condensing water, and at the same time producing a vacuum in the condenser ready for the engine to start with a good vacuum. Some of the direct-acting steam pumps, as made by Messrs. Hayward, Tyler and Co., and Messrs. Tangye Bros., are applied to that purpose. We understand also that the Pulsometer Engineering Company have applied a considerable number of their extraordinary pulsometers to bilge pumping purposes. These pulsometers have the peculiarity that the steam is admitted direct on the surface of the water, without the intervention of any piston whatever. The water is raised by alternate vacuum by condensation, and then direct pressure to eject the water into the delivery pipe. The action takes place alternately in two adjoining chambers.

Another conspicuous feature in the show were the steam excavators, shown by Messrs. Priestman Brothers, of Hull, and Messrs. Appleby Brothers, of London. These excavators are self-closing buckets suspended from steam cranes, and in which a ton of earth or mud may be raised and discharged by a single attendant in about a minute, thus giving an effective work of from 50 to 60 tons per hour. These excavators are now very largely used for dredging rivers, harbours or bars, and also for excavating dock work, as they will raise from under the water just as well, or rather better, than on dry land.

Messrs. Bateman and Co. show their metalline, which has proved so very successful in its application to fast-speed bearings. We know many instances of bearings, perforated with this metalline, which are running at over 1,000 revolutions per minute, without any lubrication whatever.

The Hancock Inspirator has been already known in our columns as a capital arrangement for emptying a bilge. It will withdraw water from a depth of 23 feet, very economically, and will also feed boilers very efficiently. The Hancock Inspirator Company, of Queen Victoria Street, showed a large number of their inspirators, and other good steam valves and check valves.

In boilers we notice some capital multitubular boilers, very suitable for steam yacht and launch purposes. We illustrate that shown by Messrs. Cochran and Co., in another portion of our columns. The boiler shown by Messrs. Carter and Walker was a splendid specimen of work in mild steel. The joints were only feathered, but yet quite steam tight.

The Phosphor Bronze Company showed a considerable number of their worn phosphor bronze, which were remarkable proofs of their durability. The test bars also, returned from Mr. Kirkaldy's workshop, showed the immense ductility and strength of phosphor bronze—equal almost to steel. We look upon phosphor bronze as an equally valuable improvement on gun-metal as steel is on ordinary iron.

RAISING THE GROSSER KURFURST.

The preparations for raising the huge ironclad Grosser Kurfürst are now rapidly progressing. The shield for covering the collision hole in her side is ready for use. It is 10ft. long by 7ft. broad, oval-shaped and convex. It consists of steel plates ½in. thick, strongly rivetted and strapped together. Two rows of angle-iron, rivetted all round the edge of the shield, form a channel for water-packing of 6in. diameter india-rubber hose, which when filled will be squeezed with the shield to the ship's side by several very powerful steel screws, bolts and nuts, with very heavy crossbars inside of hole. A large scaffold for the divers to work on, made of wooden sparring and iron frames, has been constructed. While the extremely difficult and arduous undertaking of attaching the shield to the vessel is going on, various other preparations are being vigorously advanced. The engine for filling the vessel with air is a complicated but very powerful machine; it will be controlled by a Westinghouse governor, in case of sudden mishap during operations to any of its parts. Leading engineers in London have invented a pair of shears for cutting wire rigging under water with the greatest despatch. When the vessel comes to the surface, by the aid of powerful pontoons, a dozen divers will be engaged in cutting her free from the confused entanglement of wire rope attached to her broken masts and spars, at present buried in the ground under her.

OUR Scotch correspondent says that in addition to what has appeared in our columns and elsewhere regarding the arrangements for the forthcoming summer meeting of the Institution of Mechanical Engineers in Glasgow, it has been arranged that on Wednesday the 6th of August, the second day of the meetings, after papers shall have been read, excursions will take place to the works of the Steel Company of Scotland at Newton, and the North British Ironworks—Mr. Ellice's—at Coatbridge, opportunites being also afforded for visiting Gartsherrie and other works in that quarter. On Thursday, the 7th, Messrs. Denny will entertain a company, and show them over their shipbuilding works at Dumbarton. Visits will also be made to important works in Glasgow. Among the papers to be read are a number of considerable interest. Several local engineers will make contributions to the list.

CORRESPONDENCE.

[It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions referred therein. We will with pleasure insert any letters likely to benefit our readers either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience. —Ed.]

THE PAY OF MARINE ENGINEERS.

To the Editor.

Sir,—"A Foreign-going Engineer" has written to you on the subject of engineers' pay. Will you allow me to say I quite agree with him as to the first part of his letter, and also as to there being some slight Board of Trade examination for young thirds, to "prove their knowledge of something about engines," but at the same time there are plenty of chiefs who hold certificates who are not fit to serve in the capacity of thirds, let alone anything else.

But I should like to ask him, what young man, who has the slightest amount of respectability to keep up, would serve as "greaser" for six months, doing trimmer's work. There is one thing, you see, Sir, when any one has arrived at the top of the ladder, it does not matter what is suggested for young fellows starting.

Was this "Foreign-going Engineer" ever an unlucky third, who gets the blame for everything—or in what way did he make a start in the engine-room? Would he have liked to have gone as "greaser?"

Then again, as for saying a third does not know a piston from a propeller, after serving his time in the shop—it does not say much for the firm he has served with. I am also at a loss to see how the "recruit's" intellect can be improved by his serving as "greaser" for any length of time; but there, perhaps I am thick-headed. Meanwhile, Sir, I am,

ANOTHER FOREIGN-GOING ENGINEER.

To the Editor.

Sir,—A correspondent says he did not see any mention made of a reduction in the home-going engineers' pay. Allow me to inform him that two years ago they suffered a reduction of five shillings per week, leaving them £3 10s. and £2 10s., and some as low as £8 5s. and £2 5s. I wonder if your correspondent would like to be in the home trade for any less? Being at home every week, this is the life. Going into dock one tide and coming out the next; going in at low water and coming out at high water, is not out of the question.

Newcastle-on-Tyne. W. V. M. E.

LAUNCHES AND TRIAL TRIPS.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the Marine Engineer *as complete and reliable as possible, and will thankfully receive all such information or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 26th of the month.*—Ed.]

LAUNCHES.

Barao-Desdiogo.—On the 3rd July a screw steamer, named the Barao-Desdiogo, was launched from the shipbuilding-yard of Messrs. C. Mitchell and Co., at Low Walker. The dimensions of the new vessel are:—Length over all, 200 feet; beam, 23 feet; depth, 14 feet. She is the property of the Macahè and Campos Railway Company, Brazil, and is the last of these vessels, nearly identical in build, constructed by Messrs. Chas. Mitchell and Co., for that company. The vessel is fitted with a long full poop for the accommodation of first-class passengers. As the steamer has been rather a long time on the stocks she was launched fully rigged. Compound engines of 100-horse power, with all the latest improvements, will shortly be fitted on board the vessel.

Mary Louise.—On the 3rd July there was launched from the building-yard of Mr. J. P. Rennoldson, South Shields, a paddle tug steamer of the following dimensions:—100 feet by 18 feet 6 inches by 9 feet 9 inches. She is built of wood and copper-fastened throughout, and will be classed 9 years A1 at Lloyd's. Her engine will be fitted by the builder, and is on the side-lever surface-condensing principle, of fifty horse-power nominal, having multitubular boiler, working pressure 45lbs on the square inch, feathering paddle wheels and steam windlass. This vessel, which combines all the most recent improvements that have been applied to tug steamers, has been built to the order of Mr. Jas. Wardle, of the Dardanelles, where she is intended to be employed in the towage and salvage services. On leaving the ways she was named the Mary Louise by Miss Minnie Veitch, of Exeter.

Scotia.—On the 3rd of July Messrs. Raylton, Dixon and Co., launched at Middlesbrough the Scotia (s), which has been built to the order of Mr. J. M. Lennard, of Middlesbrough. The Scotia is an iron steamer, 240 feet long, 31 feet 6 inches beam, and 16 feet depth of hold, and will carry about 1,450 tons deadweight. She has long raised quarter-deck to bridge, iron main deck, four hatches, and three steam winches. The whole of the hold is reserved for carrying space, the saloon and cabin accommodation being under the bridge. The christening was performed by Mrs. Lennard.

Castleton.—On July 5th a three-decked iron screw steamer was launched by Messrs Schlesinger, Davis and Co., from their yard at Wallsend. This vessel has been built for Mr Matthew Cope, of Cardiff, under the superintendence of Mr. Plews, and her principal dimensions are:—Length between perpendiculars 270 feet; breadth moulded, 33 feet 6 inches; depth of hold, 23 ft., with full poop, under which are the cabins, state rooms, bathrooms, &c., for captain and passengers. The engines will be fitted by Messrs. R. and W. Hawthorn, of Newcastle, and are compound surface-condensing, with cylinders 32 inches and 62 inches diameter, with a stroke of 40 inches. The steamer was named the Castleton by Mrs. Plews. This vessel will be commanded by Captain Jones, late of the screw-steamer Prince Soltykoff.

M. A. Wilkinson.—On the 5th July a schooner of the following dimensions was launched from the building-yard of Mr. Robert Cock, at Appledore, viz.:—Length, 76 feet; breadth, 20 feet; depth 9 6-10 feet; tonnage 98 N.N. She is the property of Captain R. Wilkinson and others, and is intended for the general coasting trade, under command of Captain T. Kelly Screech, formerly of the Bessie Wilkinson. On leaving the ways she was named by Miss Wilkinson, daughter of the principal owner, the M. A. Wilkinson.

Morea.—On the 5th July a screw steamer, built to the order of Messrs. Taylor, Cameron, and Co., of Liverpool, was launched at West Hartlepool, by Messrs. William Gray and Co. Her dimensions are:—Length, 270 feet; breadth, 34 feet; and depth of hold, 23 feet 3 inches; her gross tonnage is 1,700 tons; class 100 A1 built in excess of Lloyd's; she ranks as a three-decked cargo boat. Her build is as follows:—Complete double bottom, all fore and aft, for water ballast; long poop for passengers and officers, bridge midship for engineers, &c., topgallant-forecastle for the crew, four powerful steam winches, steam windlass, and all latest improvements suitable for rendering the ship a first-class fast general cargo boat to trade out of Liverpool. As the steamer left the ways she was named the Morea by Mrs. Nelson Cameron, of Liverpool.

Carthagena.—On the 7th July a steamer was launched from the building-yard of Messrs. Bartram, Haswell and Co., South Dock, of the following dimensions, viz.:—Length, 312 feet; breadth, 36 feet; depth, 25 feet 6 inches; tonnage, gross register 2, 341; nett 1,521 tons, with very large capacity for cargo. The vessel is of the highest class at Lloyd's, viz., 100 A1, will be rigged as a three-masted schooner, is fitted with Messrs. Emerson and Walker's patent windlass, has four large hatchways each provided with one of Messrs. Clarke, Chapman and Gurney's steam winches, has water ballast in her holds, iron decks, six bulkheads, steam steering gear, and will be supplied with compound surface condensing engines of 200 nominal and 850 indicated horse-power, by Mr. John Dickinson, of Palmer's-hill Works. As she left the ways she was christened the Carthagena by Miss Pinkey. She has been sold to W. M'Murray, Esq., of London, and will be principally engaged in the Spanish trade.

Presto.—On the 17th July there was launched from the building yard of Messrs. C. Mitchell and Co., at Low Walker, on the Tyne, an iron screw steamer, built to the order of Messrs. R. B. Fenwick and Joseph Reay, of the Pelton Colliery Company. The steamer has all the latest improvements for facility of loading and discharging her cargo. The vessel is 222 feet long, 31 feet beam, and will carry about 1,300 tons deadweight on a light draught of water. On leaving the ways the ship was named the Presto by Mrs. Waddington. She was afterwards taken to receive her engines, which will be fitted by the Wallsend Slipway and Engineering Company.

Rebecca.—On the 19th July, a screw-steamer was launched from the yard of Palmer's Company, Jarrow, built to the order of Messrs. Joseph F. Cohen and Owners, London, for the Mediterranean and Atlantic trades. The vessel is 250 feet long 33½ feet broad, and 23 feet deep, and will carry 2,400 tons. She will be fitted up with Palmer's engines, and will have all the modern appliances. Mrs. A. M. Cohen, wife of a Newcastle shipowner, named the vessel the Rebecca as she left the ways.

Potaro.—On the 19th of July Messrs. Edward Withy and Co. launched from Middleton Shipyard, Hartlepool, an iron screw steamer, which has been built to the order of Mr. George Steel for Messrs. Steel, Young, and Co., of London and West Hartlepool. This is the thirteenth vessel they have launched for the same owners. Her principal dimensions are :—230, by 13.6 by 17.6 and 21.6. She will class 100 A 1 at Lloyd's, and has long raised quarter-deck, bridge-house, topgallant forecastle, iron Liverpool house for passengers aft, water ballast in both holds, and iron decks. She will be schooner-rigged, and be supplied with three of Archer's patent steam winches, which. amongst other improvements, are fitted with Napier's patent brake. Compound engines of 110 horse-power will be supplied by Messrs. T. Richardson and Sons, of Hartlepool Iron Works, and the vessel is expected to be ready for sea by the middle of August. Before leaving the ways she was christened Potaro by Mrs. Young, of London.

Cid.—On the 21st July Messrs. M. Pearse and Co. launched from their iron shipbuilding yard, at Stockton-on-Tees, an iron screw steamer of the following dimensions, viz :—Length between perpendiculars, 245 feet; extreme breadth, 33 feet; depth of hold to top of floors, 23 feet. This vessel has a gross tonnage of about 1,500 tons, and a carrying capacity of about 2,000 tons. She has been built under special survey, and classes 100 A1 at Lloyd's; is built off the three-decked rule, with main and upper decks of iron; short full aft and topgallant forecastle, rigged as a three-masted schooner with foresail and double topsails on the foremast, and fore and aft sails on the main and mizen mast. She is fitted with double bottom for water ballast; four double cylinder horizontal steam winches, and all the other appliances for loading and discharging cargoes are of the most recent and improved description. The engines are on the compound principle, of 130 horse-power, and are made by Messrs. Blair and Co., of Stockton. This steamer is built to the order of R. J. Kay, Esq., of Birtley, and is the sixth one built by M. Pearse and Co., for that gentleman. As she left the ways she received the name of Cid, the usual ceremony being performed by Mrs. Pearse.

Comus.—On the 24th June Messrs. Charles Connell and Co., Scotstoun, launched an iron sailing barque of 150 tons, for Messrs. Barton and Co., Glasgow, to be employed in their East India trade. Like the former vessels built for them by Messrs. Connell and Co., she has several extras beyond the highest class at Lloyd's, and is fitted with all the latest improvements. As she left the ways the wife of Captain Hall, who is to command the vessel, named her Comus. Immediately after the launch she was towed to her berth to load for Singapore.

Lifeguard.—On the 24th June, Messrs. A. and J. Inglis, Pointhouse, launched a screw steamer named Lifeguard, for Sir James M'Garel Hogg, the principal dimensions being 125 by 20 by 9, and class at Lloyd's 100 A 1. She is to be fitted by the builders with compound engines. On leaving the ways the ceremony of naming the vessel was performed by Mrs. Shaw, of Magheramorne.

Polly.—On the 1st July the Campbeltown Shipbuilding Company launched from their yard, at Trenchpoint, an iron vessel, built to the order of Messrs. M'Ilwraith, M'Eachran, and Co., London, for their coasting trade in Australia. The vessel measures 120 feet long, 20 feet 6 inches broad, and 8 feet 6 inches deep, and is adapted to do the part of a tug steamer. She was named the Polly by Captain Mowatt, Superintendent of the Company's steamers. After being launched she was in tow by the tug steamer Flying Tempest to the Clyde, where her engines are to be fitted in.

Aha.—On the 3rd July there was launched from the shipbuilding-yard of Messrs. H. M'Intyre and Co., Paisley, a screw steamer schooner-yacht, named the Aha, of the following dimensions :—Length 50 feet, breadth 12 feet; depth 6 feet. She was built to the order of Captain Sadler, of the screw steamer State of Indiana, for the purpose of illustrating the advantages of deep immersion of the propeller. She is fitted with a lifting and lowering propeller, which is so arranged that it can be lowered almost its half diameter below the keel, or it may be lifted up clear of the water altogether, so that in a fair wind, when the sails are set, it will offer no obstruction to the speed. She is fitted with Ferguson's patent triple-action engines, which admit of the shaft being only a few inches above the keel, and are the lightest and most compact engines known in proportion to the power they develope. The engines are constructed by Messrs. Fleming and Ferguson, of Paisley, and are intended to indicate 70 horse-power.

Primrose.—On the 5th July there was launched from the shipbuilding-yard of Messrs. T. B. Seath and Co., Rutherglen, a double-ended iron saloon steamer, being the first of three steamers being built to the order of the Wallasey Local Board, Egremont, and intended for the passenger ferry traffic between Egremont, Liverpool and New Brighton. The vessel on leaving the stocks was named the Primrose by Mrs. Steven, wife of the Chairman of the Wallasey Local Board. The Primrose is built with all the latest improvements, and is of the following dimensions :—Length 150 feet, breadth 25 feet, depth 10 feet 6 inches, and is of a most novel construction, being divided by seven cross and several longitudinal bulkheads into 12 watertight compartments, making her almost unsinkable. Her deck saloon measures 90 feet long by 12 feet 6 inches broad, and she will be fitted with steam windlass and steering gear. The machinery is constructed by Mr. D. Rowan, engineer, Elliot-street, Glasgow, and consist of a pair of diagonal oscillating surface condensing engines of 90 horse-power nominal, with cylinder 36 inches in diameter with 3 feet 5 inches stroke.

Eagle.—On July 7th there was launched from the shipbuilding-yard of Messrs. Scott and Co., Cartsdyke, a steam yacht of 65 tons, Y.M., named Eagle, which has been built to the order of Count Stackelberg, of St. Petersburg. The yacht is rigged as a schooner, with a large spread of canvas. The engines manufactured by the Greenock Foundry Company, are of the direct-acting inverted cylinder type, and will work at a pressure of 90 lbs.

Claudius.—On the 8th July Messrs. Alex. Stephen and Sons launched from their yard at Linthouse an iron screw steamer of about 1,450 tons and class A 1. This vessel has been built to the order of C. Andersen, Esq., of Hamburg, and was named Claudius by Messrs. Heeckt, wife of Captain Heeckt, who is to take command of the steamer. The keel of the Claudius was laid on April 4th, only three months and five days previous to launching, and the vessel was launched with all her machinery complete on board.

Pongola.—On the 9th July Messrs. M'Millan and Son, Dumbarton, launched the screw steamer Pongola, a vessel of about 1,300 tons and 180 h.p., owned by Messrs. Bullard, King, and Co., London, and built for their services between London and Port Natal. She has a commodious saloon, with first-class cabin accommodation for about 40 passengers. The steamer is fitted with water-ballast, and has very large displacement on a light draught to enable her to take a full cargo over the bar at Port Durban. She is classed 100 A1, and is furnished with everything on the most improved system to suit the special trade for which she is intended. The Pongola received her name from the wife of the Commander, Captain Brown.

TRIAL TRIPS.

Oxton.—On the 27th June the new screw steamer Oxton went down the Clyde on a trial trip of 40 miles, and to adjust compasses. The weather during the run was very stormy, and tested her sea-going qualities. This vessel is fitted with two duplicate sets of compound engines, which worked very satisfactorily. She is propelled by four screws, and both ends of the vessel are similar; steers at either end. The steamer turned and manœuvred with the utmost facility, and in its own length. She is divided into eight watertight compartments, and built to the highest class. The trial was under the inspection of Mr. Reid, engineer, on account of the owners, who expressed himself well satisfied with the properties of the new steamer, which has been constructed for the Commissioners of Birkenhead by Messrs. W. Simons and Co., Renfrew. The Oxton left the same afternoon for the Mersey.

Earl of Jersey.—On the 28th June, the new steamer Earl of Jersey, built by Palmer's Shipbuilding and Iron Company (Limited), Jarrow, to the order of Messrs. Martin Marquand, Cardiff, had her trial trip at sea. The vessel is 210 feet long, 30 feet broad, and 15 feet deep, and her carrying capacity is 1,150 tons. The engines are of 100 horse-power nominal, and 650 indicated; the cylinders are 26 inches and 50 inches respectively, the stroke of the piston is 36 inches, and the working pressure of the boilers is 80 lbs to the square inch. The steamer, which is classed 100 A 1 at Lloyd's, is intended for the general trade, and will be commanded by Captain Jones. During the trial across the measured mile a mean speed of 10¾ knots per hour was obtained. Throughout the trip the engines worked with a smoothness unusual in a new vessel, and the trial, as a whole, was of a very satisfactory character.

Retriever.—On June 28th the new screw steamer Retriever, built and engined by Messrs. Blackwood and Gordon, Port Glasgow, for the Telegraph Construction Company, went down the River Clyde on her trial trip. She is fitted with all the latest improvements, including Alderman's new patent windlass. A correspondent who happened to visit Port Glasgow yesterday, informs us that out of five new steamships boarded by him, four were fitted with this new windlass, recently patented by Mr. A. J. Alderman, of London. After adjusting compasses at Garelochhead she ran the measured mile at Skelmorlie. The speed was 11·33, which, considering the strong breeze and heavy sea, was satisfactory.

Salamander.—On June 30th a trial trip of the new steam yacht Salamander, built for Fred Power, Esq., by Forrestt and Son, took place on the Thames. The vessel has a large amount of accommodation for her tonnage. Her dimensions are 91 by 12·6 by 7.6. Having taken the owner on board at Blackwall, the Salamander proceeded to Southend and back. The principal features of this yacht are the engines, which worked most satisfactorily throughout. They are upon the Perkins' system, compound and condensing, working at the high pressure of 500 lbs per square inch. Although not more than half-power was used during this trip, they proved to be quite enough for the vessel, the consumption of fuel being about one-third the ordinary amount, and no smoke being visible from the funnel.

The Inchmornish (*s*).—This steamer, which has been built by Messrs C. Mitchell and Co., Newcastle, for Messrs. Hamilton, Fraser and Co., Liverpool, has taken her official trial, prior to joining Messrs. Donald Currie and Co.'s service to the Cape. She made an average speed on the measured mile of 11½ knots per hour, with about 1,500 tons dead weight on board, and immediately afterwards started for the Thames, reaching Gravesend within 29 hours against a very heavy head wind. The steamer has engines of 225 horse-power by the Wallsend Slipway and Engineering Company. The vessel has double bottom, two iron decks, and carries about 3,000 tons weight.

Thunder (*s*).—On 3rd July the steamer Thunder, belonging to Mr. J. Watkins, and which has had new machinery and a large general overhaul, reclassed, and obtaining No. 1 Board of Trade certificate, took her trial trip under supervision of Board of Trade surveyors. The speed at the measured mile was 11¼ knots. The ship afterwards proceeded to Free Trade Pier to load for Hamburg.

The Eileen.—The steam yacht Eileen, built by Messrs. A. Leslie and Co. for Mr. George Robert Stephenson, was taken to sea on her trial trip on the 3rd July. The day was not altogether favourable for a first run; nevertheless the vessel attained a rapid speed and proved capable of ready manœuvring. She is 108 feet long, 16 feet beam, and 12 feet deep; her tonnage being 120 tons. The engines, which are from the Locomotive and Marine Engine works of Messrs. R. Stephenson and Co., are compound, of 45 horse-power, and work at a presure of 90 lbs. The yacht made the usual six runs over the measured mile, and attained a speed of 13·17 knots per hour, the engines working admirably and giving the utmost satisfaction.

The official trial of one of the first-class torpedo boats built by Messrs. Yarrow and Co, of Poplar, for the Austro-Hungarian Government, was made on Friday, July 4th, in the presence of Count Cassini, naval attaché to the Austro-Hungarian Embassy and Herr A. Waldvogel, Chief Engineer to the Austrian Navy, when a speed was obtained during an entire hour's run of 21·3 knots. The dimensions of the craft are 86 feet in length by 11 feet beam, and her machinery is of 450 horse-power.

The Emerald.—This steamer, which has just left the hands of Messrs. Dobson and Charles, shipbuilders, Grangemouth, made her trial trip on the Clyde on July 10th. The steamer has been built to the order of Messrs. James Hay and Sons, Glasgow, and is intended for their West Coast trade. She is 460 tons gross. Her engines are made by Messrs. Dunsmuir and Jackson, Govan, and attained 10½ knots under easy steam, equal to 11 knots, which is above expectation. The owners as well as the company present, expressed themselves well satisfied with the steamer, both as to its finish and speed. A trip was made down the Forth and round Inchkeith.

The Rio Apa.—On the 12th of July the paddle-steamer Rio Apa, which was built in Port Glasgow, for the National Brazilian Steamship Company, went on her trial trip. Among the principal novelties of her construction are the hull and boilers, which are entirely of steel, combining lightness with the necessary strength. The machinery, which has been supplied by Rowan, is of the most approved construction, and the proper ventilation of the engine-room and stoke-hole has been secured by a new apparatus designed by Messrs. Rowan and Cameron. The speed estimated on the measured mile was about 12 knots per hour. The steering can be effected from three separate parts of the vessel, which is supplied with Muir and Caldwell's steam steering gear. Table and cabin accommodation is provided for 120 first-class and 200 third-class passengers, also stowage for 540 tons cargo.

The Fire Queen.—This steamer went down the Clyde on July 17 on her trial trip, and after running between the Clock and Cumbrae at a speed of 10¾ knots, and cruising about the Firth, was taken over the measured mile at Skelmorlie, where she attained a mean speed of 11 knots an hour. She has been built by Mr. James E. Scott, of Greenock, and her engines, which have been constructed by Messrs. James Howden and Co., of Glasgow, are of 100 horse-power nominal, cylinders 25 inches and 48 inches by 33 inches stroke, and 70lbs pressure of boiler. Her appliances for the loading and the discharge of cargo consist of two steam cranes and two steam winches. Her dead-weight carrying capacity is 650 tons. The steamer is owned by Messrs. Henry Lamont and Co., Glasgow, and is designed for their carrying trade between Glasgow and Liverpool.

The Highbury.—On the 19th July the screw steamer Highbury built by the Tyne Iron Shipbuilding Company (Limited), Willington Quay, for Mr. E. H. Watts, London (of the firm of Messrs. Watts, Milburn, and Co)., had her trial trip at sea. The vessel is 270 feet long, 35 feet broad, and 24½ feet deep. Her engines, which have been supplied by Messrs. R. and W. Hawthorn, Newcastle, are of 200 horse-power nominal, and are fitted with Hawthorn's improved steam reversing gear and Durhani's velometer. The cylinders are 32 inches and 62 inches respectively in diameter, the stroke of the piston is 42 inches, and the working pressure upon the boilers is 80lb. to the square inch. The steamer has been built under Lloyd's special survey, and is intended for the general trade, and her commander is Captain Garson, of North Shields. The vessel, after taking on board a cargo (dead weight) of 2,700 tons of coal, was taken to sea to have her compasses adjusted. The vessel was steered solely by the steam gear, and the way in which it was worked was highly satisfactory. The speed of the vessel was a little over nine knots per hour.

Polly.—On July 19th the Polly (s), built by the Campbeltown Shipbuilding Company, proceeded on her trial trip, having been loaded with coal, so that her speed might be ascertained at her load draught. The speed attained was nearly 10½ miles per hour under easy steam. She has been fitted by Messers. Dunsmuir and Jackson, Govan Engine Works, with compound engines of 45 horse-power, having a working pressure of 80 lbs. She has been built to the order of a London firm, and leaves shortly for Queensland, where she has to be employed in the coasting trade.

The Rotomahana (s).—This steamer, built by Messrs. William Denny and Brothers and engined by Messrs. Denny and Co., of Dumbarton, for the Union Steamship Company of New Zealand, arrived at Gravesend on Monday evening, July 21st, after a stormy but rapid run from the Clyde, having accomplished the distance from the Cloch Light, on Clyde, to Gravesend in 52½ hours, which is claimed to be the fastest run ever made, and equal to an average speed of 13½ knots. The Rotomahana is a steel screw steamer of 1,730 tons gross, fitted with a double bottom for half her length, and classed 100 A1 at Lloyd's. She has accommodation for a large number of first and second-class passengers, has been built to carry out the mail service between Australia and New Zealand, and is expected to shorten the time at present required on that service by fully a day.

Vasco da Gama.—This steamer, which was recently launched from the shipbuilding yard of Mr. W. B. Thompson for Messrs. Robert M'Andrew & Company, London, went down the river last week to test the efficiency of her engines.

Puchoco.—This steamer, which was built by Messrs. Gourlay Brothers for the Pacific Steam Navigation Company, Liverpool, went down the river on her trial trip last week.

THE CHINESE GUNBOATS.—The trial of four gunboats supplied by Sir William Armstrong and Co. to the Chinese Government, took place last week. These vessels are called the Epsilon, Zeta, Eta, Theta, in succession to the four previously sent out. The trial was witnessed by the Admiralty and War-office authorities, as well as by the Chinese ambassador and suite. The gunboats steamed down Spithead and fired their heavy guns both with blank cartridge and Palliser shot. Each boat carries one 35-ton gun, with an enlarged chamber, which gives it much greater power than the 38-ton gun at present in our service. At the conclusion of the trial, which was very successful, the boats started together for Plymouth, *en route* for China.

NOTES AND NOVELTIES.

THAT steamships are superseding sailing ships very rapidly, both for home and foreign trade, becomes more apparent with every fresh publication of Board of Trade statistics. In the foreign trade alone steam tonnage shows an increase of 10 per cent. for 1879 as compared with last year, whilst a corresponding decrease is noticeable in sailing ships employed in the same trade.

THE digging of a canal from Cronstadt to St. Petersburg is making such progress that Admiral Possiett, who directs the work, assures the Government that in a year's time vessels of small size will be able to pass from the sea to the Neva, and that in the summer of 1881 the canal, the depth of which is fixed at 20ft., will have been excavated to the extent of 16ft., enabling a goodly-sized craft to reach the capital.

FOR the New Jersey ship canal to unite the Passaic and Hackensack rivers with the Hudson, and effect a saving of about twelve miles by water between Newark and New York, three routes are reported to be under the consideration of General Newton, to whom the Government has entrusted the duty of making the surveys. One would pass directly from Newark Bay through Bergen Hill, by a cutting of 4732ft.; a second would take a diagonal course through the Lill, and save about 250ft. of cutting over the first; and the third would follow a straight line from Newark Bay, near the beacon light, to a point midway between the two bays, where they intersect the Morris Canal, and thence follow the line of the canal to New York Bay.

MAMMOTH TOWING STEAMER.—The *Pittsburgh Chronicle* says that the coal firm of W. H. Brown have just entered into a contract with Fried Krupp, of Essen, Germany, for the manufacture of a steel shaft for a new mammoth towing steamer now building in Pittsburgh; and then adds:—"The boat will be ready by the time the shaft will arrive from the old country, and the firm is convinced that they have done the right thing to venture on this unusual step. It will, we hope, have the effect of developing another branch of industry in Pittsburgh. Not one of our steel manufacturing establishments possesses the 'plant' necessary for casting and shaping such huge pieces of material as the necessities of the river trade demand. Colonel Schoonmaker, of the firm, loyally exhausted all local possibilities before he resorted to making the arrangements mentioned. But that the manufacture of steel shafts will be introduced here is now a matter of certainty. A large establishment could find plenty to do, considering that we have seven or eight hundred steamboats in the Western waters, nearly one hundred and fifty being owned in Pittsburgh—the majority of which would seek to supply themselves with such shafts could they be furnished here. The shafts to be made by Krupp will be 27 feet long, and 15 inches in diameter, tapering to 13 inches, and will weigh in the neighbourhood of 20,000 pounds. The price for open-hearth steel is nine cents a pound, free on board in New York. The wheel of the new boat will be 26 feet, with sixteen buckets, each 32 inches deep."

IN consequence of the increase of trade at the Jarrow Shipbuilding Yard, it has been determined by Messrs. Palmer to enlarge their existing slipway, which has been sufficient for the trade for over 20 years. The slipway is to be lengthened 200 feet, and over the whole extent, from the entrance wall, it will be considerably widened, so as to enable two of the larger class of steamships to be cradled and worked at the same time.

CELERITY IN CLYDE SHIPBUILDING.—The new iron screw steamer Claudius, of 1,450 tons, built and engined by Messrs. Alexander Stephen and Sons, Linthouse, Govan, for Hamburg owners, left the Mineral Terminus Quay, Glasgow, last Wednesday morning for compass-adjusting at the Gareloch, and thereafter to run on her maiden voyage to Constantinople and Galatz. She carried nearly 2,000 tons of coal, put on board in less than a couple of days at the steam cranes. The Claudius is a remarkable example of the celerity with which vessels can be constructed on the Clyde, her keel being only laid on the 4th of April last, and she was launched on the 9th inst., and took her departure early on Wednesday morning, being six days after launching. Her boilers, engines, and interior equipments were all fitted up before she was placed in the water. The whole time occupied in her construction and loading was three months and twelve days—for a vessel of her size and tonnage an almost unexampled feat.

REVIEW.

Navigation and Nautical Astronomy. By the Rev. W. T. Read, M.A. (Elliot Stock, Paternoster-row.) This is an excellent and remarkably readable volume upon subjects as above, about which there are very few similar text-books extant. The present time is particularly suitable to the introduction of such a volume, as much is now being done to raise the character of instruction to mercantile marine officers. This book has for its author the Mathematical Instructor on board H.M.S. Worcester (the Rev. W. T. Read), who has certainly acquired that most difficult art of presenting a dry and scientific subject to his readers in a concise, interesting and intelligible manner. Although it is of absolute necessity that trignometrical terms should be both used and understood for the proper exemplification of both navigation and nautical astronomy, yet we are glad to see that no unnecessary complicity has been used in the methods of expression, and there is even a very great deal that may be read and understood with advantage without even that amount of mathematical knowledge. The book opens with some excellent information about the compass—its causes of deviation, its method of adjustment on iron ships, and some capital practical hints even as to the best way of laying an iron ship on the building slips, whether for North or South latitudes; and also best positions for after equipment to annul as far as possible the magnetization of the hull. The methods of sailing, whether plane, traverse, parallel or great circle, are all well defined and explained with examples for use. The method adopted in this book is in our opinion a capital one. When a subject is introduced, a few terse words simply but thoroughly explain the meaning, use and object of the subject, and then the examples immediately follow. Every new subject, or branch of the subject, is clearly outlined by the headings of the paragraphs, so that no page in the book is an undistinguishable map of print as is so often the case in scientific books, making hard subjects infinitely tedious and confusing. The portion on nautical astronomy is most valuable, not only to sailors, but to all who may have to decide their position in new explorations by their own observations. The chapter on Longitude by Chronometer, the most useful of all problems at sea, is capitally written and so simple that any sailor with a fair education should be able easily to master it. The subject of deviations on board iron ships, and their corrections due to any given position of the head of the vessel, is wisely paid great attention to, as there is so much iron now afloat. The closing chapter is most important, giving the investigations and analytical proofs of the rules most generally in use in navigation and nautical astronomy.

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Smith, John S.	2 C	Greenck.
Muir, Charles ...	2 C	do.
Cranston James	2 C	do.
M'Intyre, Archb.	1 C	do.
Gibson, John ...	1 C	do.
Allison, Alex ...	1 C	do.
Kyles, Thomas...	1 C	do.
Asplet, Geo. P....	1 C	do.
Marns, Thomas	2 C	N.Shilds.
Rutherford, R. C.	2 C	do.
Kinloch, Wm...	1 C	do.
Brewis, John M.	1 C	do.
Brotherton, R ...	1 C	N.Shilds.
Naylor, Jno......	1 C	do.
Strathairn, Wm.	1 C	do.
Martyr, Jno.......	1 C	Hull.
Park, Thos. H....	2 C	Sthmptn
Hall, Thomas ...	2 C	London.
Wright, C. W....	1 C	do.
Kay, Alfred R....	1 C	do.
Mace, Jno. H......	1 C	do.
Denbigh, Geo. E.	2 C	Bristol.
Tweedy, J. J......	1 C	do.
Thompson, J.......	1 C	Plymth.
Hastings, David	2 C	Lvrpool.
Jackson, Wm......	2 C	do.
Dick, George......	1 C	do.
O'Brien, James...	1 C	do.
Riddell, Wm......	1 C	do.
Greenshields, W.	2 C	do.
Balfour, Murray	2 C	do.
Watt, William...	2 C	do.
Adamson, David	1 C	Livrpl.
Thomas, Thos.,...	2 C	Sndland.
Davidson, W....	2 C	do.
Davies, Thomas	2 C	do.
Kidd, Frank......	2 C	do.
M'Donald, Jas....	2 C	do.
Heslop, Jno......	1 C	do.
Hammond, Hy....	1 C	do.
Thomson, R. M.	1 C	Hull.
Caiger, Emery J.	2 C	London.
Scott, Henry ...	2 C	N.Shilds.
Wilson, Robert	2 C	Leith.
Segge, John......	2 C	do.
Ramsay, A. W....	2 C	do.
Twendale, Alex...	1 C	do.
Sharp, Robert.....	1 C	Lvrpool.
Wharrier, R. A...	2 C	London.
Angus, Duncan...	2 C	do.
Chappell, W. H.	2 C	do.
Cameron, W. T.	2 C	do.
Wood Geo. W.....	2 C	do.
Buchanan, G. R.	2 C	do.
Duguid, John...	2 C	do.
Harding, John E.	1 C	do.
Hanley, Wm. J.	2 C	Lvrpool.
Macdonald, Jno...	2 C	do.
Hildreth, Geo. A.	2 C	do.
Duffus, James...	2 C	do.
Fisher, Fredk...	2 C	Lvrpool.
Brownfield, Jas...	1 C	do.
Green, David......	1 C	do.

Robert Jackson, Registrar-General.

General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

Obituary.

The *New York Times* says:—"Mr. William Cramp, the well-known shipbuilder, died on the 6th of July, in his 72nd year. Apprenticed to the then principal establishment in its line in Philadelphia, Mr Cramp began business 50 years ago in a small way, and founded the firm of William Cramp and Sons, the most extensive iron shipbuilding concern in the country. They have constructed 225 vessels of various descriptions. Five iron cruisers for the Russian Navy have been built at the works during the past year. The last was the Jabiakia, which was contracted for under 1,000 dollars a day forfeit, and finished in time. The Bridgewater, built 27 years ago, and at that time the largest of her class in the country, is still afloat, and five years ago sold for as much money as was originally paid for her. At the present time 1,500 persons are employed at the works, and last year there were 3,000 workmen in the place. The largest iron freight ship ever built in the country is now being constructed. She will be 2,000 tons measurement, and have a capacity for carrying 8,000 bales of cotton. Mr. Cramp leaves five sons, four daughters, and 39 grandchildren. He belonged to that race of old Philadelphians who originated the great industrial establishments of the United States."

Recent Applications for Patents connected with Marine Engineering, Ship Construction and Mechanical Appliances for use in Ships, from June 17 to July 21.

Supplied by the City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

Automatic marine engine governors (communication C. W. Cooper), A. M. Clarke. 2404.
Vessels for transport of boats, &c. (communication H. Satre), B. J. B. Mills. 2416.
Steam generators and engines, D. Clerk. 2423.
Steam ferry for transport of vehicles, &c., P. L. Henderson. 2445.
Steam boilers, J. Warish. 2448.
Floating baths, J. Billhaud. 2453.
Lubricators, C. W. Cadman. 2456.
Valves, C. Bentley. 2457.
Governors, T. Browett. 2473.
Prevention of oxidation of screw-propellers, C. N. Dunderdale. 2484.
Valves and taps, T. Sutcliffe. 2495.
Concave key nail fastening (communication T. W. Kirby), A. M. Clarke. 2499.
Buoys and life and property saving apparatus, J. Clayton. 2504.
Waterproof garments, G. H. Griffin. 2505.
Working steam ferry traffic and loading and discharging vessels, R. B. Bell and P. L. Henderson. 2516.
Marine safety signal, W. J. Barker. 2520.
Sail hanks and fastenings, V. Coombe. 2525.
Steam engines (communication C. S. Tegnander), L. A. Groth. 2568.
Steam engines, H. E. Brecknell. 2570.
Furnace-bars, G. Hopewell. 2579.
Waterproof clothing, J. Neville. 2589.
Elevators (communication S. A. Bates, J. J. McCormick, and R. Lidell), G. F. Redfern. 2593.
Sleeping berths and ship's furniture (communication D. Huston), W. R. Lake. 2607.
Telegraphic cable, A. Blondot and J. Bourdin. 2629.
Apparatus for immersion of telegraphic cables, A. Blondot and J. Bourdin. 2656.
Lubricating apparatus, H. Myer. 2660.
Propelling machinery, S. W. Snowden. 2667.
Rotary engines, P. Davis. 2673.
Steam engines, E. W. Anderson. 2692.
Ejectors, A. C. Henderson. 2703.
Compasses (communication S. Longfellow), W. R. Lake. 2705.
Dredger buckets, chains and attachments, W. R. Kinipple. 2715.
Packing for glands, pistons, &c., W. Wolff. 2722.
Lubricators (communication C. Parshall), H. J. Haddon. 2739.
Steam Boilers, J. Cassels. 2760.
Steam boilers, J. Ellwood. 2764.
Grain discharging apparatus, J. Gillett. 2766.
Elastic bottom for berths. T. P. Frost. 2777.
Engines and pumps, (communication A. G. Waterhouse and B. B. Brewer), J. and J. A. Baker. 2824.
Piston packings (communication S. A. Youse), A. M. Clarke. 2865.
Sounding Apparatus, W. Moseley and T. S. Trumble. 2876.
Valves, H. Tipping. 2913
Chains, W. Deakin. 2926.
Windlasses, &c. (communication O. Stegmeyer), M. Sebg. 2934.
Ship's light (communication J. Garein), A. M. Clarke. 2943.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

ADVERTISEMENTS must be sent in not later than the 23rd of each month to ensure insertion in the following number, addressed to W. G. Neal, 3, Amen Corner, Paternoster Row, London, E.C.

NOTICE TO THE TRADE.

THE "Marine Engineer" is now published by Grattan Marshall & Co., 3, Amen Corner, Paternoster Row, London, E.C. to whom all orders should be sent and P.O.O'S. &c., made payable. Yearly Subscriptions, 5s.

The Marine Engineer.

LONDON, SEPTEMBER 1, 1879.

EDITORIAL NOTES.

LAST month we had occasion to note the important resisting effects offered by compound steel-faced armour to the impact of the hardest shot. As if to deride the efforts of armour makers to produce plates capable of resisting the effects of our large marine guns, Messrs. Krupp in Germany, and the Italian Government at Spezzia, have been showing what the guns can do. All the armour plates exposed to fire were completely shattered, both of iron and steel. The Italian Government experimented in especial upon steel plates, and are said to be considerably disappointed at the results. That is to say, they were disappointed at not obtaining better resistance from the plates, but at the same time must have been pleasurably astonished at the enormous penetrative power of their new 100 ton gun from Elswick. It must be pleasant for our Naval Service and Government to discover that we are at last absolutely being beaten in the power of armaments by other Governments. And what must be still more galling, is that the 100 ton gun belonging to the Italian Government, and experimented upon at Spezzia, there proving itself to be the most powerful gun in the world, is made by Sir William Armstrong of Elswick. It is surely time for us to be bestirring ourselves when we find our heaviest piece of ordnance the 80 ton Woolwich gun, beaten both by the Italian Armstrong gun, and Krupp's 71 ton gun. Our Service 38 ton guns, unchambered, have absolutely not so much penetrative power as Krupp's 18 ton gun. We shall be finding Chinese gun boats armed with Krupp's guns, which will be able to over-match our heaviest iron-clads.

A COMPLETELY novel form of gun, much admired at Meppen during Krupp's experiments, was a muzzle-pivoting gun. This gun is mounted in a very peculiar manner. The muzzle of the gun is enlarged, and spherical, so as to form a ball and socket joint in the armour of the battery. The breech is so supported, that it can be trained through an angle of about 30 degrees right or left, up or down. The gunner sits astride the gun on a saddle, and sights it through a small aperture above the gun. An iron or steel convex shield is external to the battery, and can be made to rise or fall easily by a counterpoise, so as to protect the mouth of the gun, so that it would scarcely be jammed by the impact of a hostile projectile. The gun is mounted in an iron casemate, formed by sloping sides and a flat roof; which is intended to be further covered in with earth. The gun has ample room inside to traverse on a rail through the total deviation of 60 degrees. The gun itself is about 6¾ inches calibre, and takes a charge of about 14½lbs. of prismatic powder. Its accuracy was very marked, as at a range of 600 yards this gun put seven shots out of twelve within a space of 18 inches square, and the remainder were not much more widely scattered. The penetration of the gun is exceptionally good, as there is no recoil, but a solid resistance by the armour. The vibration and concussion are so little that it can hardly be felt in the casemate, and a coin placed on the gun-metal was not shaken down.

IN spite of the long continued depression in the shipping trade, we note that a new dock has just been opened at Blackwall as an extension to the East and West India Docks. Its area is about 6 acres. It has exceptional advantages in the depth of the entrance lock and new basin. At ordinary spring tides there are 31 feet of water above the stone sills against which the lower edge of the gates fit, and the largest ocean-going steamers can thus enter the basin for some time before and after high water. This, it is said, is a greater depth by some 4 feet than is to be found in any other dock in the Thames. The wall of the dock has a total thickness of 20 feet at the bottom, and 8 feet at the top, and is formed of Portland cement concrete, faced with 3 feet of stock brick-work. The gates and cranes are worked by hydraulic machinery, and rails for prompt communication with the Railways are laid throughout the quays. The lock is 65 feet wide, and fitted with two pairs of wrought-iron double-skinned gates. The works cost about £240,000.

The gun accident at Wilhelmshaven, in which one of Krupp's 24-centimetre cannon exploded with such disaster to the crew has created a great deal of interest by way of comparison with the accident on board the *Thunderer.* Herr Krupp communicates his own opinion of the matter to be that the accident was owing to the bursting of the shell in the bore of the gun. The gun was blown into three parts, but did not burst explosively into a number of pieces. The front portion was blown forward into the sea, the back parts against the inside of the turrets, whilst the centre remained fixed in the trunnions. It was found that the breech piece and wedge had sustained no injuries, but would operate with as much ease as before the explosion, thus showing the excellence of its design and construction. Previous to the accident it was known that there existed in the gun two long gutterings in the shot chamber, and from examination of the gun after the accident it was found that these gutterings had developed into cracks, which had united together in front and extended round the periphery of the inner tube behind. The lead coating of the projectile has a very fatal error, viz., that the condition of the projectile cannot be known, and it has often happened that the heating of the shell preparatory to and during the operation of loading has caused the shell, and particularly a chilled shell, to crack. After this the break up in the gun is pretty certain. The cause of the accident may then be traced to the shell allowing in the first instance the passage of the gas over it, and thus scoring the gun very deeply, and secondly to the jamming or bursting of the shell in the gun and thus developing the guttering into cracks and dividing the inner tube.

Our naval instincts of defence are still energetically devising fresh means against the diabolical methods of attack and destruction that seem to increase steadily around. The torpedo scare has been the last fright for our unfortunate sailors — sneaking, diabolical machines, that will explode and send a good ship to the bottom without the least warning. A harbour defended by sunken torpedoes has been thought practically impregnable. We find, however, that a trial of a new method of clearing harbours of sunken torpedoes has lately been tried with every promise of success. The apparatus was fixed on the gunboat *Bloodhound*, at Portsmouth, and consists in running out a couple of booms 30 feet in length from the bows of the ship. Across the submerged ends is fixed a horizontal beam 38 feet in length, having a zig-zag arrangement of iron rods in the form of a W. It is expected that the open space of each V as it is pushed through the water, will enclose the torpedo fastenings or connections and lead them to the point at the bottom. The V's are here fitted with a scissor contrivance which is worked by levers in connection with the capstan on board. The beam-searcher has a sweep of 50 feet and the mechanism is capable of cutting through the strongest electric cable. A net which is supported from the whiskers of the bowsprit receives the liberated torpedo, and prevents it exploding against the operating craft. We understand that the trial was a great success, and the plan will be largely adpoted. The invention is by a Captain Arthur whilst in command of the "Vernon."

In another part of this issue we have given illustrated details of a very simple and efficient sliding door for water-tight bulkheads. We think this subject is an all important one to those who trust their lives to our present iron ships. A leak is easily caused, and is almost impossible to promptly repair on an iron hull, so that the vessel must depend for safety, under leakage, almost entirely on its water-tight compartments. When we hear, as is quoted in the article above referred to, that a sea-going engineer, essaying to shut one of the usual screwed water-tight doors, found it took half an hour to effect the operation, it is forced upon our conviction that such an arrangement would be perfectly useless in time of need. The main reason for this, no doubt, is the present principle of water-tight doors, to force down, by a screw arrangement, a sliding door which is only so used after an accident requiring its immediate operation. Any engineer should know that under such circumstances, the gear would never be in easy working order, and therefore never ready for prompt application. We do not see that any forcing down arrangement is necessary, for if the sliding faces should have been injured no hand screw will effect the closing. And at the same time, it is ten chances to one the screw itself would also have been bent, in which case the gear would be rendered useless, and the *door could not be shut.* There is an excellent maxim in all railway signal arrangements that any hitch to the working or breakage will only stop the traffic, not allow it to go on to it's destruction. We think the same principle ought to be applied to measures of precaution for the saving of life, that the only possible result of accident or damage should be, not to destroy saving efficiency, but at most to cause inconvenience. This may well be applied to the doors in question. In existing arrangements an accident by shot or straining would prevent the door from being closed, and thus from being serviceable in its protective sense. Under Mr. Simey's new system, any jamming of the door—which is already by habit and rule kept closed—or any carrying away of the lifting gear, would only inconvenience for the time, and leave the door fully serviceable for protective purposes.

THE Wreck Commissioners have made a report to the Board of Trade upon the loss of life attending the lowering of a boat from the *Albert Edward* on its passage from Folkestone to Boulogne on the 22nd of July, 1879. They report that the *Albert Edward* was duly provided with boats according to the Merchant Shipping Act. That three smaller boats would have been better than the two large ones, and that they would have been better slung on davits outboard rather than on chocks inboard. That, as regards the lowering gear, the after tackle had too many leads in it, so that it could not be paid out as freely as the forward gear, and would be likely to become jammed. The Commissioners find the superintendent of the Company's boats and the master of the *Albert Edward* to blame for having allowed the defects in the after davit to remain so long without remedy. Also that the master was to blame for not having taken proper measures to see that the boat was free from water before starting, and also that the master and mate are to blame for not having seen that a man should always be stationed at each fall.

WATER-TIGHT BULKHEADS.

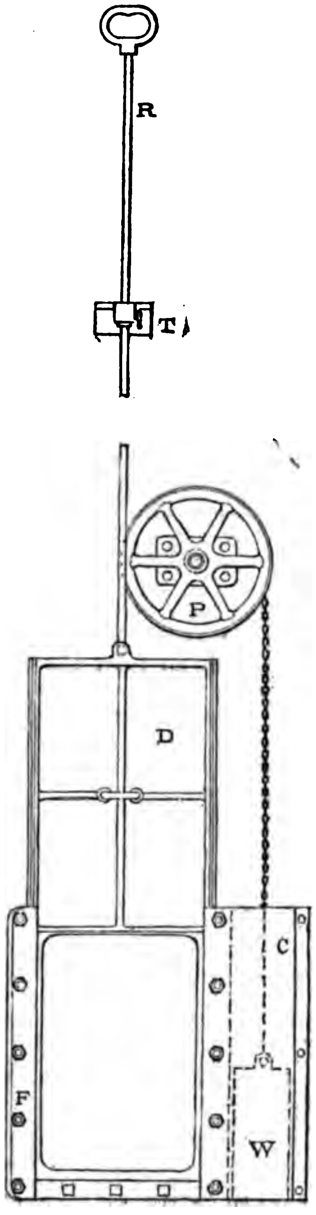
THERE can be no doubt whatever in the minds of all who now sail in iron ships that their lives are held only by a precarious tenure, and that in case of collision or sudden leakage their safety depends entirely on their water-tight bulkheads. This may sound to some an exaggerated statement, but it is now generally well known that it is most difficult if not almost impossible to stop a leak in an iron ship. The only chance, then, of saving the ship is to divide her into a number of water-tight compartments, so that even if one or more be filled sufficient buoyancy may remain to the ship to keep her afloat.

This can only be effected by a perfect system of water-tight bulkheads, and in order to facilitate communication these bulkheads must be supplied with water-tight doors. So we come back to our original proposition that the safety of an iron ship almost entirely depends upon an effective system of water-tight doors.

There have been grave charges of inefficiency against the operation of the water-tight doors at present in use in the navy and mercantile marine. The frequent and lamentable founderings immediately following a collision or grave leakage speak of themselves to the practical inefficiency of the water-tight compartments, which are intended as a protection against such accidents.

The inefficiency of the present system without doubt consists in the fact that the doors cannot be closed with sufficient promptitude after the occurrence of a disaster, when all is confusion, and time is exceedingly limited.

We find a letter before us from the engineers of a steamer, supposed to be as well fitted as the average with water-tight doors in the bulkheads closed by screw tackle. This engineer assures us that on trying to close one of the doors, fortunately when the ship was repairing only, and although it appeared to have been at least as well attended to as such doors generally are or can be, yet the operation of closing was so retarded by rust and the corrosion that constantly occurs that it lasted half an hour. Such a



condition of affairs would certainly ensure foundering with a bad leak.

We illustrate herewith a bulk-head door, arranged on a new principle by Mr. C. R. Simey, of Sunderland, who, instead of seeking a solution for an easy closing door by a more intricate gear or hydraulic action, reduces the conditions to the simplest possible base. The best way, he argues, to insure a rapidly-closing door after accident is to have the doors already shut before accident, and the best way to ensure that the doors shall be shut before accident is to supply an *easy opening* door which must remain shut by rule, and only be opened to allow a passage through. This is certainly the acme of simplicity, and the wonder is that this system has not long before been adopted.

To render his door (D) easy of opening, Mr. Simey counterbalances the weight of the door by a weight (W) over a chain pulley (P). The door runs in grooves as shown in the plan, and is kept in its place by the cheeks (F). The weight (W) works inside a light wrought iron case (C).

The necessity of opening these doors, whenever it is desired to pass through them, is the best possible means of ensuring that everything is in good order and oiled.

To the top of the door is attached a rod (R) which passes up to the deck above, so that the door may be either shut from above or below. Set screws can be used on the brackets (T) at any of the decks to jam the rod (R), so that the door may be securely held closed when exposed to the wash of the water after collision.

This gear is very simple, and consequently cheap, and seems to us much preferable to any arrangement such as that used in Her Majesty's Navy, involving the use of screw tackle to shut the door, and gearing and rods to do so from the main deck. In any case of straining or injury by shot or shell, we think that any bending of a screw rod or breaking of gearing is certain to jam the door and prevent its subsequent action, in a much greater degree than in the system of Mr. Simey.

DENNY & CO'S SHIPBUILDING YARD.

THE members of the Mechanical Engineers during their late meeting at Glasgow, visited the shipbuilding and engineering works of Messrs. W. Denny and Brothers, Dumbarton, where a large amount of work is being performed of the most interesting and diversified character. Indeed, at a time when the shipbuilding trade throughout the country is at a lower ebb than it has been for many years, when numbers of yards on the Clyde are practically closed, and when many on the north-east coast are doing but little, it is surprising to see how busy the little town of Dumbarton is kept going. It would be invidious to dilate upon the cause of this, but it is sufficiently well known that Mr. W. Denny, with enormous application and intrepidity, throws his whole heart into the business of the building yard, and is foremost among Clyde shipbuilders in the determination to compete, and to compete successfully, against the enterprising builders of the Tyne, Wear, and Tees, in spite of some disadvantage as to the cost of iron. Energy and enterprise, when tempted by ability and shrewd business qualifications, always count for much, and especially in large establishments, for it affects, and imparts enthusiasm to the whole organisation. Messrs. Denny are busy both in shipyard and engine works, and are equally fortunate in the management of both, and bid fair to turn out as much work this year as they have done even in the most prosperous times.

They have at the present moment ten ships in hand, and of these no less than nine are of steel. The following are some of their particulars, and it will be seen they vary in size and type, from light draught steamers for the Irawaddy, to Peninsular and Oriental and transatlantic liners. First, we may mention a large awning-decked building of steel for Messrs. James and Alexander Allan, of moulded dimensions 385 ft. by 42 ft. by 34 ft., classed 100 A 1 at Lloyd's, and built with a continuous cellular double bottom, worked into the structure of the ship throughout her length. She has also deep plate frames 12 ft. apart, and intercostally-arranged side stringers, in addition to the ordinary frames spaced 24 in. apart. The construction of the double bottom, and the arrangement of deep web frames and itercostals, as carried out in this vessel, are two of the greatest improvements introduced of late years in mercantile ship construction. This double bottom construction has been already fitted to several ships, and is being rapidly adopted by other builders, especially since Messrs. Denny challenged the Board of Trade as to the tonnage measurement, and compelled the Government to measure only to the top of the inner bottom instead of down to where ordinarily the top of the floors would be. This is a matter of importance to the tonnage dues, especially where the vessels perform short voyages, or trade through the Suez Canal. We have not space at present to describe and illustrate in detail the system of construction here alluded to, but we hope soon to be in a position to describe it from its first introduction, and illustrate the various modifications that have been introduced to meet the requirements of various sizes and types of ships. The machinery of the Allan steamer will consist of a pair of compound surface-condensing engines—cylinders 51 in. and 88 in., stroke 54 in.—having two double-ended steel boilers, with 8100 square feet of heating-surface. The gross tonnage of this steamer will be about 4000 tons. She is now nearly all plated and rivetted. Next in point of size is a screw steel steamer for the 'Peninsular and Oriental Company, of moulded dimensions, 380 ft. by 40 ft. by 28 ft. 2 in., to be classed 100 A 1 at Lloyd's. This steamer is, with the exception of the arrangement of deep web frames, being constructed on exactly the same system as the above-mentioned Allan steamer, and has a continuous cellular double bottom throughout her length worked into the structure. She is the ninth steamer constructed with this system of double bottom within two years by Messrs. Denny. She will have a long poop, topgallant forecastle, and midship house, and will be fitted with a pair of compound surface-condensing engines, having cylinders 54 in. and 94 in diameter, and 5 ft. stroke, with six iron boilers. At present her keel is being laid.

Further advanced, but of smaller dimensions, is a steel screw steamer, classed 100 A 1 at Lloyd's, with flat plate keel and deep bilge keels. Moulded dimensions, 270 ft. by 34 ft. by 25 ft. This steamer is constructed with a continuous double bottom, the same as the foregoing, and is just in frame. She will have a pair of compound surface-condensing engines, having cylinders 36½ in. and 63 in. in diameter, 52 in. stroke, and four boilers of iron having 5,000 square feet of heating surface. Her owners are the Union Steamship Company of New Zealand, the owners of the Rotomahana, a vessel just completed by Messrs Denny, which did a mean speed of 15·4 on the measured mile, and is for her size the fastest ocean-going steamer afloat. She has been much admired for her yacht-like appearance and beautiful fittings, and in spite of heavy weather recently made the fastest passage on record by several hours from the Clyde to Gravesend.

Next in importance come a group of five light-draught steamers building of steel, to be shipped abroad. 1. One paddle steamer of moulded dimensions, 250 ft. by 30 ft. by 9 ft. Her sheer is reversed, and droops towards the ends. Her strengthening is principally obtained by forming the coal bunker bulkheads, at the sides of the engines and boilers, into two continuous bowstring girders which run nearly from end to end of the steamer. Her engines consist of a pair of compound diagonal jet-condensing engines, having cylinders 34 in. and 59 in. in diameter and 54 in. stroke. These engines are framed almost entirely out of the hull, a method which strengthens the hull and saves weight. 2. Two steel paddle steamers, 160 ft. by 24 ft. by 8 ft. 3. Two steel paddle steamers, 160 ft. by 26 ft. by 8 ft.

These four steamers have engines similar to the first, only smaller, and constructed in much the same way. All the foregoing five paddle steamers are building for the Irawaddy Flotilla Company, and will be shipped in pieces to Rangoon.

Besides these W. Denny and Brothers are constructing a small and peculiar paddle steamer in steel for Mr. W. J. M. Larnach, of

Dunedin, New Zealand. She is intended for ferry service there, and is designed to run on a draught of 2 ft. 4 in. fully coaled, and with her complement of passengers on board. Her moulded dimensions are 80 ft. by 15 ft. by 8 ft. amidships, and 5 ft. at the ends. Her peculiar design arises from the fact that several conflicting requirements were insisted upon in her. Besides the extremely light draught already mentioned, two different decks were required; one for first-class passengers, and one for steerage passengers, and in the same way two cabins. She was also required to be strong enough to stand an occasional run in rough weather. By raising the steamer amidships, strength, cabin accomodation, an upper deck for the first-class passengers, and complete cover for the machinery were obtained. By means of the sponsons, rivetted on to her sides, a lower deck was obtained for steerage passengers.

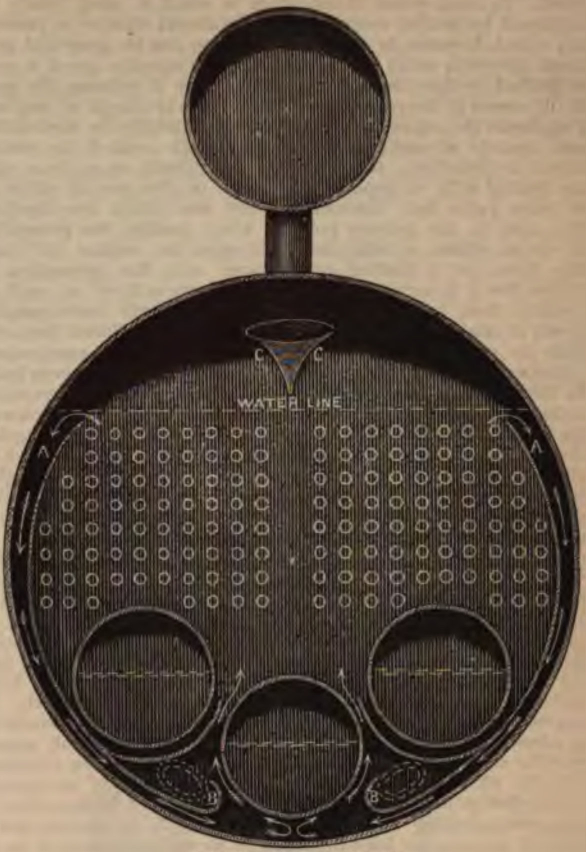
This little steamer will be fitted with a single surface-condensing engine, framed as in previous cases out of the hull, and having one cylinder 15½ in. in diameter, and 24 in. stroke. The boiler will be of steel 6 ft. in diameter, and 6 ft. 6 in. long, having a working pressure of 80 lb. and 220 square feet of heating surface. For lightness the condenser is being made out of sheet iron. This steamer is partially in frame. The other paddle steamers are in various states of progress, the largest and two of the small ones being nearly ready for shipment.

Messrs. Denny and Brothers have also just received the order for a paddle steamer for China of considerable size, to be constructed of iron on the deep-plate frame principle already referred to in the case of the foregoing deep-sea steamers. This vessel will be sponsoned after the American fashion, and fitted with a walking beam compound engine having its gallows frame of iron.

It will be seen from the foregoing that the yard of Messrs. Denny is as remarkable for the variety of the work it contains as for its quantity, and this will, to a great extent, explain the exceptionally strong and efficient draughting and designing staff maintained. Few in the present day have the courage to keep so large and powerful a draughting staff together, and still fewer extract the full value from such a staff, but where this can be done it well repays the outlay, and where it is neglected it is a sure forerunner, in the present day, of decay and decrepitude. Among the many ways of increasing the efficiency of the yard, Messrs. Denny have introduced a large amount of the most modern and improved machinery, both for working in iron and in wood. Among the former may be mentioned an admirable machine for straightening plates, of German origin, a multiple drill specially suitable for keel bars, &c., and a punch capable of taking out at one stroke, from an inch or any thinner plate, a full size man hole. The wood-working machinery at this yard is specially interesting.

Another matter of interest in the yard is the testing machine, which is exactly similar in size and construction to that recently erected at University College, London, under the direction of Professor Kennedy. Some most interesting experiments had, we understand, been recently conducted by Messrs. Denny at this machine, bearing upon the comparative strength, ductility, and rigidity of steel and iron as used for shipbuilding, also, as between shingled iron and shingled steel, and as to the effect of annealing and partial annealing on beams and beam arms. But perhaps, more curious than either of the foregoing was a series of experiments to ascertain how far the element of time affected the testing of steel, and whether by breaking the specimens very rapidly or very slowly, the ultimate strain or the amount of extension before fracture was seriously affected. These results, have not, we believe, been hitherto published, but we venture to hope Messrs. Denny will place them at the service of the public, for they are, for the most part experiments made in a direction hitherto unexplored, and possessing much interest for all those concerned in the use of mild steel. In the matter of steel shipbuilding, as in modern structural improvements Messrs. Denny have taken a decided lead, and it might be supposed they would gain more by withholding the results of their large experience. The reception of the Mechanical Engineers, and the freedom with which the whole establishment was thrown open for inspection shows, however, that a more enlightened policy, and we believe, a wiser one, is followed, and we can only express our hope, as it is our conviction, that such a policy may continue to command the prosperity which it so richly deserves.

We understand that a greatly improved Whitehead torpedo has lately been perfected at Woolwich, and that experiments are now being conducted with it at Portsmouth. This new pattern differs materially in some important points from the Whitehead torpedo supplied to other countries from the works of Fiume.



SECTION OF BOILER,

Showing Mr. H. Fergusson's arrangement of a self-acting circulator of water in the inside of boilers or steam generators. The water courses are shown by the arrows. The lines A A represent partition plates which extend from the front of the boiler to the combustion chamber. Numerous tests in models and full-sized Marine boilers demonstrated that the temperature is almost equal throughout the shell of the boiler from the time the fires are lighted, consequently equalizing the expansion, and provision is made for receiving any "salt," "scum," or corroding matter that may be present in the water, the same being deposited in the early stages of circulation in the pockets B B, thereby obviating "fitting" of the shell or tubes by such matter. It also prevents priming, as shown by the inverted cone C C, which is placed immediately below the passage to the super-heater at a given distance.

CIRCULATING WATER IN BOILER.

The following paper was read by Mr. Hugh Ferguson before the Marine Engineers' Association, Liverpool, on June 30th, 1879:

The object of generating steam with the least possible consumption of fuel is occupying daily the special attention of some of the most celebrated engineers, and in many instances decided improvements have been made. We frequently find, however, that these improvements are specially confined to the construction of engines, and mainly directed to the economisation of steam; boilers, or steam generators are only occasionally dealt with. This disregard of the motive power of an engine may arise from the fact that the generating of steam is to a great extent concealed, or that a better means for investigating the subject must be brought to bear upon it before much advancement can be made in this direction. But with the knowledge we possess it is a truism that beyond adding strength to the steel and increasing the heating surface by multiplying tubes little has been done. It might be said at a venture that in many cases marine boilers are made subservient to the carrying capacity of the vessel, being shaped and placed to suit coal and cargo arrangements. Under these conditions, in many instances, we will find that too small a space between the crown of the boiler and the water line has been preserved for giving off safely the quantity of steam required to supply the engines on these occasions, when the vessel has steamed every pound that can be made to urge her through a gale; or it may be from off a lee shore where huge waves and rugged headland meet, and where the work of annihilating life and property would be sharp and short. In cases where steam space is small it need hardly be explained to marine engineers that imminent danger is present. My object, however, is to show how steam can be generated in a short time with entire safety, and that the manufacture of it may be pushed to the utmost limits without fear of priming, the most fertile source of danger and anxiety to those in charge of engines. For, should the engines be perfectly laid and fitted by the most skilled and accurate of workmen, it will be of little avail if the motive power is defective; therefore it is incumbent upon those who are trusted with so important a charge to give special attention to those parts that demand the first and fullest investigation. We refer to the primary portion, which portion, the generating of steam, claims a first place. It must be evident to those who have but a limited acquaintance with the generation of steam, that it is very essential to have the water freed as much as possible from impurities—the first and hitherto unconquerable power of muriatic acid and sulphate of lime, which latest forms the scale or crust on the shell, fire-boxes, tubes, and combustion-chambers, and remain on for a short time in a tolerably even body. In this state it is considered by many to be of service in preventing radiation of heat through the shell; but those most experienced with the irregular expansion and contraction of boilers agree in saying that the non-expansive nature of the scale renders it liable to crack or chip off, exposing small portions of the shell or flues to a higher temperature and to the immediate action of muriatic acid. By this acid the mechanical operation of pitting is performed. The scale, then, under these circumstances, is a most productive source of deterioration. Many efforts have been made to neutralise the destructive power of this acid, but excepting the introduction of blocks, of zinc placed or hung on the stays inside the boiler, which to a certain extent mitigates its corrosive nature, we have still to contend with a power as to the effect of which no definite conclusion has been arrived at. Therefore, we are not surprised to find the ages of boilers so short, and especially when we see how little attention is given to equalise the temperature of the shell. It appears to me that the best way to get over the difficulty would be to adopt some means by which the scale might be evenly spread over the shell. If the ingredients forming it cannot be extracted from the water, and the muriatic acid held in a state of suspension so as to further neutralise it, means must be adopted for preventing it from concentrating on any exposed parts. To accomplish this I think it necessary to have the water in a continuous state of circulation, as shown by the diagram. Under these conditions no particles in its nature foreign to the sulphate of lime, which forms the scale, is likely to settle on its surface, which particles, I fear, in the present comparatively dead state of a large portion of the water, is the cause of the scale cracking or chipping off so irregularly and so frequently; for, apart from the motion given of a marine boiler by the pitching and rolling of the vessel, we have no adequate means for accomplishing a complete and continuous circulation of the water. This oscillating motion I apprehend to be the cause of the barnacle-like formations that accumulate on the undersides of the fire-boxes and tubes, and especially lodging by the seams and rivet heads. As we have already said, zinc has and is being used to neutralise the muriatic acid; but I am inclined to think that the use of zinc tends to make the scale more brittle and porous without destroying its affinity to iron—at least, as it is at present used, we frequently find the scale having a shelly appearance on those parts where the heat is greatest, such as on the tops of the fire-boxes and tubes, and on the underside and bottom of the boiler we find the scale, in form more of the nature of the honeycomb, lodging all the earthy and quiet corroding matter that may come its way.

For purifying the water many apparatuses have been in practice. The brine pump in its day acted a good part, but the condensing engine of to-day dispenses with it, from the fact that the small quantity of water necessary to supply the loss caused by escape of steam, or the occasional blowing off is so limited, that it is a comparatively easy matter to have the water well freed from salt. To ensure the greatest amount of salt or other matter being blown off, it is most desirable to open the cocks, when the pressure gauge indicates about 8 or 10-lbs of of steam, which pressure will give a temperature of about 220°, the heat at which salt deposits, and without doubt, the best time for separating it from the water by blowing off. At this stage great evils are obviated, as all the heavy matter settles down to the bottom of the boiler, and it is immediately before the acids form and separate from it.

The next important process in use for cleaning the water is the scum cock, being very good in itself, but if not used at the proper time it might as well be dispensed with. The time this cock ought to be brought into use is immediately before the water arrives at the steam-giving point, say about 200°. A free use of the scum cock when the water is at this temperature will, I have no hesitation in saying, be found highly beneficial in removing from the surface of the water those phlegm-like particles that gather on it at this stage, and is only removed (if not scummed) to the sides and ends of the boiler, when the water commences to ebullate, and where its deleterious effect are found to be most destructive. The difficulty of removing it by the use of the scum cock when making steam, may be said to be limited to mere chance. Due attention being given to blowing off and scumming, it is also necessary to be careful how the feed water is distributed in the boiler. At present we find the mode by which the condensed steam or feedwater enters the boiler is by a single pipe discharging itself against the underside of the fire-box, or some one of the bottom plates, which in a short time never fail to wear out these parts, and keep the temperature in the immediate vicinity lower than it will be found in any other part of the boiler. To guard against the danger arising from this direct gouging out of the plates by the feed water and dangerously low temperature in the bottom of the boiler, we recommend that a series of pipes leading along the fire-boxes, and placed so as to be in direct contact with the rising heat, the pipes to extend the full length of the fire-boxes, and placed in line with the top of the side furnaces, and perforated on either side within the space of the third segment on the top side with $\frac{3}{8}$-in. holes, and about 3-ins. apart, by having the feed water so distributed and raised above the water, that is, so far removed from the sources of heat, it will then be found that the latent heat absorbed by the water in the bottom of the boiler remains unchanged.

This will ensure a more equal expansion in the bottom plates. The difference between the temperature of the feed water and the water giving off steam is very considerable and demands special attention. With steam at 60 lbs. pressure to the square inch we will find the temperature to be about 290°, while the feed water will not be more than about 100°. It will thus be necessary to impart 190° of heat to this water to keep up the required pressure. In the event of increasing the pressure, under the present arrangement, the evils referred to will be aggravated in ratio beyond all proportion.

We now come to the question what means should be adopted to secure uniform circulation of the water, to equalise the temperature and so separate the injurious ingredients from the water, or place them where their power will be reduced to a minimum. A reference to the *diagram* will perhaps enable us to arrive at a conclusion which may at least be an improvement on the present.

In this *diagram* we have the section of a three furnace boiler with the usual number of tubes, in fact the ordinary boiler of the day. But our purpose is to improve it, and with that object we feel justified in asking your careful consideration of this arrangement of partition plates, placed longitudinally in the boiler, and extending from the front of the boiler to the combustion chamber, and from the surface of the water passing between the fire bars and the shell, and terminating in a quick curve at the bottom end. This curve forms the mud pocket, and it is so situated and carefully guarded against any agitation from the water, that all matter carried by the circulation of the water is likely to settle here, and, without doubt, remain until removed by hand. The curve *here shown* is carried up to about 6 or 8 inches above the fire bars of the centre furnace, and being under the side furnace serves as a protection to the mud pocket, while it renders the circulation of the water complete, and makes the nearest possible approach to equalising the temperature throughout the shell of the boiler from the time fires are lighted a condition that has not yet been attained by any other process. The partitions are so arranged that the water runs parallel with the sides of the boiler, and the scale that will form must as a natural consequence be regular in thickness, and free of any matter other than the sulphate of lime; the current of the water prevents anything wanting in affinity to settle on it, and those particles that would otherwise mix with it will be carried to the pockets in the early stages of circulating. The current at the bottom of the boiler is equal in velocity with any other part, and, being the same on either side, the currents meet immediately beneath the centre furnace, when they diverge from each other as shown by the arrows, and pass up the sides and over the furnace, to receive the necessary amount of heat for being converted into steam. In referring to the course of the water being thus directed, we find that when a globule of steam is formed on the top of the fire-box, it passes up to the surface of the water, causing in its passage a proportionate amount of displacement, and as the globule leaves the fire-box, a vacuum to a certain extent is formed, and as there is no possibility of this vacuum being filled by water from the top, the communication being cut by the partition plate running along the furnace, the only way it can be filled is by the water coming from the bottom. Now the globule, in its passage up, pushes the water to either side, making a clear way for itself to pass up, and leaving a space behind to be occupied by water from beneath; so that we have a power for forming a complete circulation without any auxiliary aid, but simply in complete accord with the natural law of demand and supply. By this arrangement it is made impossible for the water to be forced from the top of the fire boxes, as it is often the case when fires are suddenly urged and steam rapidly drawn off, whence the rather unpleasant and unsafe result of a furnace crown being crushed down, perhaps more, an explosion, that leave no one who can give a satisfactory reason for the cause of the disaster. In this case, the water being supplied from the bottom of the boiler, the greater demand makes more certain the supply. Our next consideration will be primary. To obviate the dangers arising from this cause, we propose to have an inserted cone at a given distance from the opening, leading to the superheater equal to 2 diameters of the opening, and with a base equal to 2 diameters of the opening, and in length sufficient to pass into the water. The object here is to destroy the screw-like form that steam takes in entering a narrow passage from a large surface, through a narrow outlet, invariably having a cavity in the centre. Through this cavity water passes into the superheater and on to the cylinders, to perform the work of destruction. A cone thus placed totally prevents the rotary motion of the steam, and the water that may be gathered and raised by the steam in its passage out, will pass down the sides of the cone. Such being the case, will place priming in the dangers of the past.

THE RELIABLE STEAM PUMP.

IT is instructive to note how mechanical appliances on board ship have steadily replaced manual labour in a very large number of instances. The use of steam pumps for general purposes on board ship is now almost universal. They prove very handy for deck washing, as fire engines, and in case of sudden leakage. We might not have heard of so many crews giving out after exhausting labour at the pumps, had the wooden ships of many years back been supplied with steam pumps.

The next step from the old chain pumps were improvements in hand piston pumps, but now all these are substituted by independent donkey pumps worked by steam.

There are many descriptions of these pumps now in use, but one rule which is kept principally in view for ship pumps of all kinds, is that they must be thoroughly reliable in their action.

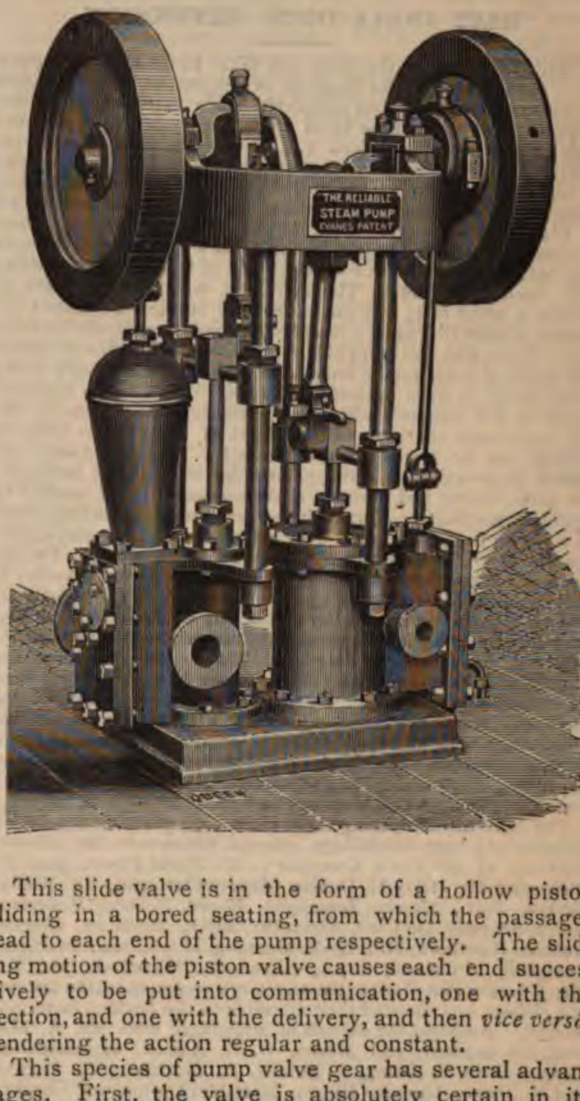
Some direct acting steam pumps, without fly-wheel, have been entirely disqualified for such purposes, owing to their liability to hang fire during work or at starting, so that they cannot always be depended upon for prompt service when required.

In some fly-wheel pumps, too, where the piston and pump are direct acting, and the fly-wheel driven by a slot crank of a side-connecting rod, a stoppage is very likely to occur on the centres when the pump is attempted to be worked at a slow speed.

The pump we illustrate well deserves the title of "Reliable" given to it by its makers and inventors, Joseph Evans & Sons, of Wolverhampton. It will be seen that the steam-cylinder and pump are mounted side by side upon a strong bed-plate, and the upper frame is supported on four wrought-iron distance columns bolted to the pump and cylinder. These bars also serve as sliding guides for the pump and cylinder cross-heads. The top frame carries two bearings, which support the two throw cranks to which the cylinder and pump connecting rods are attached.

This arrangement of crank, with its two small but heavy fly-wheels, is most efficacious in ensuring the pump from sticking on the dead centres, and we have ourselves personally inspected it only just creeping round, but still maintaining perfect regularity and reliability. This perfect regularity at a slow speed is most valuable for boiler feeding, as it is the most economical method of feeding a boiler to do so with regularity, and only supplying exactly what is required for evaporation.

The chief peculiarities of Messrs. Evans' pump is the water valve arrangement. It is not, as most frequent, a pair or series of flap, mushroom, or other lifting valves, but both the admission and exit of the water into and from the pump is effected by a slide valve operated by an eccentric from the crank shaft.



This slide valve is in the form of a hollow piston sliding in a bored seating, from which the passages lead to each end of the pump respectively. The sliding motion of the piston valve causes each end successively to be put into communication, one with the section, and one with the delivery, and then *vice versâ*, rendering the action regular and constant.

This species of pump valve gear has several advantages. First, the valve is absolutely certain in its action, as it cannot "hang up" by reason of any obstruction or grit under it. This is often the case with lift valves of any description, and much inconvenience and stoppage are frequently caused by so simple a thing as a piece of chip getting under one of the lift valves, and thus causing the water to play backwards and forwards through the valve without effective delivery.

In thick or muddy fluids it is almost impossible to use pumps with ordinary lift valves, as they will not return to their seatings again.

Secondly, another very great advantage of Messrs. Evans' & Sons' slide valve is that the eccentric driving the said valve can be easily reversed, thus reversing the action in the suction and exhaust pipes, making the former suction delivery, and the former delivery suction. This is most important where it be desired to pump two different liquids, such as salt and fresh water, or to clear an obstruction.

EAST INDIA DOCK EXTENSION.

THE Directors of the East and West India Dock Company, anxious to meet the demands of shipowners for deeper dock accommodation, have just completed some extensive works and improvements at the East India Dock, the main object achieved being a dock entrance or lock 4 ft. deeper than any other on the river. The Dock Company thus afford fresh facilities for, and give enhanced importance to, the vast shipping interest of the Port of London. They comprise a new entrance to the East India Dock at Blackwall, and an extension of the old basin, with large warehouses for export and import business, the whole being fitted with the latest and most improved description of machinery for loading and discharging ships. The new lock, which is 65 ft. wide, as against a width of 47 ft. 5 ins. in the case of the old entrance adjoining Blackwall Pier, is a few hundred yards lower down the river, and is fitted with two pairs of wrought-iron, double-skinned gates, the depth of water on the inner and outer sills at ordinary spring tides being 31 ft. as against 24 ft. 10 ins. This gives a greater depth by 4 ft. than any other dock entrance in the Thames, and the importance of this augmented depth of water to the shipping interest can be scarcely over-estimated. Special culverts and sluices are provided for drawing down the water in the basin, and the gates, sluices, and capstans at the entrance are all worked by hydraulic machinery. The basin is 6 acres in extent, and the depth of water 33 ft. The north quay is 600-ft. long, the east 455 ft., and the south, between the old and new locks, 270 ft. On the north and east quays there are ranges of warehouses 3 storeys in height, having a capacity of 15,000 tons. Two lines of rails are laid on the quay level, and, by means of a hydraulic swing-bridge over the import dock lock, communication is obtained with all the principal lines of the kingdom. These great additions and alterations have occupied a period of over three and a half years in construction, some large coffer dams, road diversions, and numerous temporary measures being required to prevent any interference with the dock business while the extension works were in progress. From the position of the basin the engineering difficulties which had to be encountered were both numerous and formidable, but have all been met and overcome without mishap.

The ceremony of opening these works took place on Saturday in presence of a large assemblage, amongst whom were the following directors of the Dock Company:—Mr. David Powell, jun. (the chairman), Mr. Harry H. Dobree (deputy chairman), Sir William Baynes, Bart., Messrs. Bosanquet, Hoare, Neilson, Robertson, Green, Schuster, Du Croz, Alexander, Blyth, Davidson, Goschen, Guthrie, Hawthorn, Hill, Lyall, Manning, Moore, Muir, Matheson, Campbell, M'Connell, Pryor, Silverlock, Woodroffe, and Tod. Mr. J. L. Du Plat Taylor (the secretary), accompanied the directors and visitors, and directed their attention to the leading features of interest. Amongst the officials in attendance were Mr. A. Manning, the engineer, and Messrs. H. S. Ashton, superintendent, Thomas Beck, F. Dring, S. Merritt, B. Stockman, R. Berwick, and H. Turner, Captains Hussey, Marrable, Dutton, and Sheppy.

At 1 o'clock some of the directors of the Company, their friends, and a few gentlemen interested in the Shipping Trade, assembled on the river quay, and the Cuzco, a magnificent vessel of 3,845 tons register, 3,000 horse power, with a length of 385 feet, belonging to the Orient Line of Australian steamers, safely entered the basin, amid the cheers of the spectators. Mr. David Powell, jun., standing by the side of Mr. H. Dobree on the bridge of the vessel, made a brief address on the happy culmination of the enterprise in which the company had been engaged, and formally pronounced the new dock open. This was a signal for general cheering, led off from the pier-head by Mr. Frank Toole, and responded to by the visitors and dock labourers on the quays. Besides the general volley to celebrate the auspicious event of the day, three specific cheers were given for the chairman of the company, three for the directors, and, finally, three for Colonel Du Plat Taylor, the secretary.

The whole of the works have been designed and carried out under the supervision of the Dock Company's engineer, Mr. A. Manning, who has been ably seconded by Mr. R. L. Berwick, the assistant engineer, and Mr. B. Stockman, the resident engineer on the establishment. Messrs. Merritt and Ashby were the contractors for the dock works and warehouses. The gates and hydraulic machines at the entrance as well as the hydraulic quay cranes have been constructed by the East Ferry-road Engineering Company (Limited); the hydraulic pumping engines of 100 indicated horse power, the mains, and the capstans by Messrs. Tannett, Walker, and Co., of Leeds, and the hydraulic warehouse cranes by Messrs. Bells, Lightfoot, and Co., of Newcastle. This enterprise has been carried out by the Dock Company at a cost of about £240,000.

THE LARGEST FERRY-BOAT.—What it is claimed will be the largest ferry-boat in the world is now being constructed at Sans Francisco, by the Central Pacific Railroad Company, to ply between Martinez and Benicia. It is to be longer than the great Pacific steamship City of Peking even, and has a greater breadth of beam than any vessel afloat. Its length is 424 ft., width 116 ft., and the wheels 30 ft. in diameter, and it will be propelled by steam generated in eight steel boilers, each 28 ft. long. The boat is a double-ender, and is steered by four rudders at each end. The hold is divided into eleven water-tight compartments, which will make it impossible to sink her. Four tracks will be placed upon the decks, which will accommodate forty-eight freight cars or twenty-four passenger coaches.

LIFE-SAVING APPARATUS.—On Saturday morning a trial of a cleverly constructed life-belt, invented by Mr. C. O. Weeks, Board of Trade Surveyor at Southampton, was made in the Southampton Docks in the presence of a large number of gentlemen connected with the shipping interests. The belt consists of a small air-tight copper vessel, which is so influenced by a concealed brass spring as to cause it to encircle the body, and by an ingenious and simple contrivance it becomes attached firmly, yet comfortably, to the person. There are no straps or tapes required, and its application is instantaneous. It possesses a buoyancy of 40 lbs., and its design allows of its stowage in a great variety of ways and places on board any vessel, so that it can be always accessible. The handiness, comfort, buoyancy, and moderate cost, and general efficiency of the belt gave great satisfaction to all present.

STEEL ARMOUR PLATES *v.* SHELLS.—A series of experiments were commenced recently at La Spezzia, Italy, in the presence of Herr Krupp, the representative of the Terre Noire Works, and others, to test the resistance of steel armour plating against a 100-ton Armstrong gun, and the respective merits of the projectiles furnished by Armstrong, Gruson, Whitworth, Terre Noire, and St. Vito. Two projectiles were to be fired against each of four Terre Noire plates, 9-ft. by 4-ft. 8-in., and 2-ft. 4-in. thick at a distance of 500 ft. from the gun. The two best were to be tried against the steel furnished by Saint Chamond. The terrible efficiency of the projectiles first tried thwarted these arrangements. The first round was fired with a projectile (San Vito) from the Government manufactory of Fossano, made of chilled Gregorini cast iron, weighing 2,022-lb., the charge being 550-lb. of gunpowder. The shell was projected with the velocity of 1,715 ft. per second. It struck the target and rebounded, and shivered in pieces, after piercing the plate to a depth of 14-in., and carrying away a third of it. The second round was fired with a Whitworth projectile weighing 2,110-lb., made of compressed steel, with a hardened point 3-in. long. The steel pierced the plate 22 in., and carrying away a third of it, passed through the backing, remaining itself almost intact. The third round was fired with an Armstrong projectile weighing 1,946 lb. The steel penetrated the plate 12-in., completely shattering and dislodging it, and rendering the target unfit for further practice, but failing to penetrate the backing. Although a Government commission on the subject has not reported its opinion, the general conviction is that these experiments fully proved the utter insufficiency of steel plates for defensive purposes.

EDDYSTONE LIGHTHOUSE.

THE laying of the foundation stone of the Eddystone Lighthouse was successfully accomplished on August 19th. It will be remembered that the historic act thus consummated was to have taken place on the 21st June, but on that occasion the weather was too tempestuous to permit of a landing. The Royal Princes, however, gave an immediate undertaking to be present again when the weather became more settled, to bestow on the occasion that *éclat* which their presence alone could impart. In fulfilment of this pledge, the Prince of Wales and the Duke of Edinburgh were once more in the three towns, and the deferred ceremony was happily executed. At the hour fixed for the starting of the Trinity yachts and the other vessels officially connected with the proceedings of the day, the outlook was not particularly inviting. There was a steady drizzle that was symptomatic of treachery on the part of the almost calm waters within the breakwater. At about 10 the various craft concerned commenced steaming into the Sound. One of the first to leave was the steamer Sir Walter Raleigh, having on board the Mayor and Corporation of Plymouth. On the last occasion some unfortunate hitch occurred to render unpleasant the experiences of this body. This time, however, no disagreeable circumstances will be linked with the recollections, in consequence of the handsome provision made by the Great Western Railway in placing at the disposal of the authorities a magnificent tender. The majority of these gentlemen were accompanied by a friend, so that in all about a hundred were accommodated. Closely in the wake of its sister boat came the comfortable Sir Francis Drake, having as its complement a party of excursionists, numbering over 200. The steamer was timed to leave Millbay Docks at 10 o'clock, but waited a half-hour for the excursionists brought from Exeter to Plymouth by the Great Western Railway. Rapidly coming from different points, and falling into a procession, were a train of vessels whose destination was the Stone. In the van could be descried the Enchantress, the Admiralty yacht, followed by the Hardy, tender to the Royal Adelaide; the Vivid, the Admiral's yacht, with a party of naval officers and their friends on board; the Trusty, dockyard tug, with the members of the Devonport Town Council and Court of Commissioners on board. From the foremast of this vessel a flag bearing the new borough arms was flying. Following the Trusty were the Perseverance, with the members of the Stonehouse Local Board, and having in tow the Plymouth lifeboat; the Sabrina gun-vessel, tender to the Cambridge; the Carron, with a party of dockyard officials on board; and the Trinity yachts Siren, Captain Lisle, from Milford, with Mr. E. Bates, M.P. for Plymouth, on board, and the Alert, Captain Tregarthen, from Penzance. The Plucky, tender to the Cambridge, and several other smaller steamers, proceeded to the Stone at an earlier hour. The scene on the journey out was exceedingly pretty and lacked but the charm of the sun's rays. The sea was found slightly perturbed, and there was a certain amount of that tossing or heaving which, while it tests the constitution of the bilious or the otherwise unsailorly, renders all the more enjoyable the trip to those by whom "up and down movements" are disregarded. Running out in all directions were private yachts with distended canvas. Scudding through the foaming surf and in relief to their white sails were the dark brown sheets of many a bold trawler. The Galatea did not get on the move until close upon 11, but when she started with her Royal passengers she cut through the water at a clipping rate. As she was hailed emerging from Barn Pool the Crews of the Bacchante and the training brigs manned the yards, and the clouds of smoke and distant booming of many guns announced to those under way some miles in advance that the Galatea was hastening to the scene. The representatives of the Press left the Alert at noon in a boat for the old lighthouse, from the summit of which it had been arranged that they should view the spectacle. On the right and on the left lolled at anchor many a steamer with serried decks, while from the rigging floated gay streamers and flags of all nations. Directly in front was lazily swaying to and fro the Hercules, which has been told off to serve the purposes of the contractors. Between the Hercules and the old Eddystone were the works on which is to rise the new beacon of hope or warning. Upon the circular dam were Mr. Douglas and the workmen, busily preparing to receive their distinguished guests. Over the side of the outworks continually rolled a wave of considerable dimensions, which spent its spray over the devoted bodies of the unconcerned labourers in this colossal undertaking. Shortly before noon the first boatload of privileged persons left the Galatea for the works, and, having landed, the flag of the Trinity Brethren was run up an improvised mast. The last to arrive on the dam were the Prince of Wales, attired in the undress uniform of a captain of the Army Reserve, and the Duke of Edinburgh in the uniform of an Admiral. Accompanying them were the Earl of Mount-Edgcumbe, the Earl of Dalkeith, Lord Colville of Culross, Lord Charles Beresford, M.P., Lord Francis Cecil, the Right Hon. W. H. Smith, First Lord of the Admiralty; Sir Richard Collensen, Deputy Master of the Trinity House; Admiral Sir Henry Keppel, K.C.B.; Admiral Farquhar, Commander-in-Chief at Devonport; Admiral Hope, Superintendent of the Dockyard; Lieut.-General Smyth, Commander of the Southern District, and his aide-de-camp, Colonel Edgecumbe; Captain Sir Allen Young, and the Rev. Prebendary Wilkinson. Their Royal Highnesses at once entered into conversation with Mr. Douglas, and that gentleman explained the mode of procedure. The Rev. Prebendary Wilkinson, who was attired in his doctor's robes, then invoked the Divine blessing on the undertaking, the assemblage standing bareheaded. The rev. gentleman first recited the following appropriate passages:—"Except the Lord build the house, they labour in vain that build it." "Thine, O Lord, is the greatness, and the power, and the majesty, for all that is in the heavens and the earth is Thine." The Vicar of Plymouth then delivered a prayer as follows:—"O eternal Lord, who alone spreadest out the heavens, who stillest the raging of the sea, and who holdest the winds in Thine hands, be pleased in Thy goodness to grant Thy blessing to this undertaking and prosper it day by day. Preserve the lives of all who are engaged in this work from accident and danger, and crown their labours with success. We lay this stone in faith and hope, and earnestly beseech Thee to grant that this important work may in Thy good providence prosper. May its light shine far over the troubled waters, and be the means of guiding many a mariner in storm and tempest and warning him of danger. May it be the means of saving life and furthering the interests of mankind for many generations. We pray Thee to behold with Thy favour our sovereign lady the Queen; endow her plentifully with heavenly gifts; strengthen her that she may vanquish and overcome all her enemies, and give peace in our time, O Lord. We also beseech Thee to bless the Prince and Princess of Wales, the Duke and Duchess of Edinburgh, and all the Royal Family. Prosper them with all happiness, and bring them to Thy heavenly kingdom. We heartily thank Thee for all national mercies and blessings, and pray Thee to pardon all our sins and to receive our prayers, which are offered through Jesus Christ our Lord."

This dedication having concluded, the Princes descended the cavity in which the stone hung ready for "laying." Their Royal Highnesses, having each been supplied with a silver trowel, freely used the cement which had been made in their presence, the cags having been slipped on to the core by a rope suspended from the Hercules. The stone having been faithfully lowered, his Royal Highness, the President of the Trinity Brethren, firmly sounded the corners with a mallet, and made the announcement, "I declare this stone to be well and truly laid," an intimation received with loud acclamation from those congregated on the reef, and taken up with great heartiness all round. Their Royal Highnesses having acquitted themselves of their functions, were conveyed to the old lighthouse, which they inspected with manifest pleasure. They were much interested in the fact that the fabric is as solid as ever, and in the explanation that the eating out of its rocky foundation has alone compelled the Trinity Brethren to supersede a structure which has survived the mighty tempests of more than a century. As the visit was now terminated, and the weather was squally, a hasty retreat was made, the Harpy being the first to decamp, followed by the Siren, the Sabrina, and the Galatea, the Enchantress bringing up the rear.

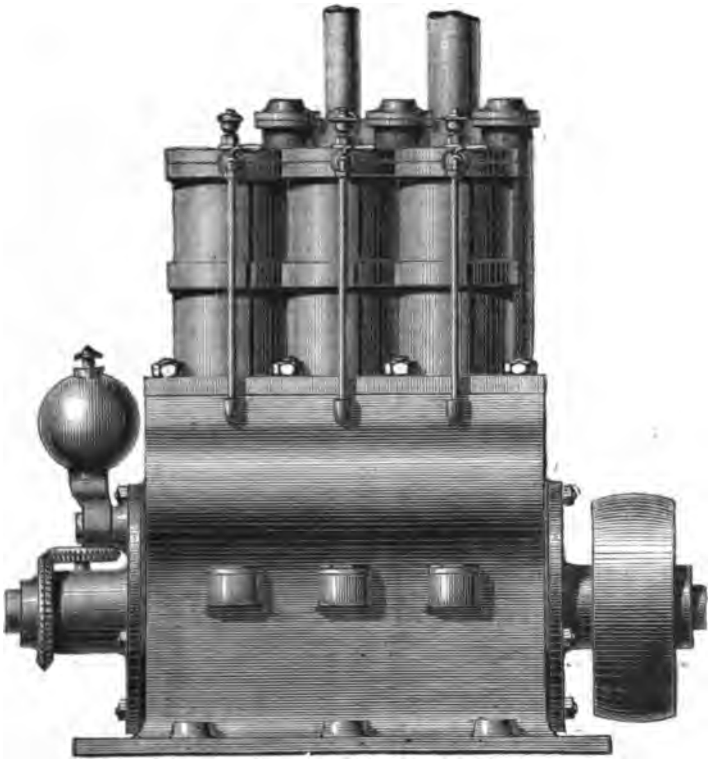
In the evening the Princes dined on board the Osborne, and the guests were W. H. Smith, the First Lord of the Admiralty; Sir Astley Cooper Key, First Naval Lord; Admiral Stewart, Controller of the Navy; Sir Massey Lopes, Civil Lord; Captain W. Codrington, Secretary to the First Lord; and the Captains of the ships in commission. During the evening the band of the 20th Regiment played on board the Royal yacht.

NEW FRENCH IRONCLAD.——An important addition has just been made to the French Navy. A new ironclad, the Devastation, was recently launched at L'Orient with complete success. She is the same type of vessel as H.M.S. Téméraire. Her dimensions are as follows:—Length, 99 metres 6 centimetres; breadth, 21 metres 25; depth, 7 metres 34; displacement, 9630 tons; horse-power, 6000. Her armament consists of four guns of 34 centimetres (13⅜ in.) in a fort protected by 11 in. plates; two 11 in. guns in half-turrets at bow and stern; and eight guns 5⅜ in. diameter. The iron skin of the vessel is 38 centimetres thick, or a little over 15 in.

WATTS' PATENT MULTIPLE CYLINDER ENGINE.

MUCH has been done to endeavour to introduce a multiple engine suitable for very high speeds, and thus fitted to drive a propeller direct and of short pitch.

The invariable principle of all the efforts that have been made, has been the use of several cylinders, generally three, to ensure constant rotation without dead points. The pistons are made single acting, so that the pressure upon them all tends in one direction, viz., to compression, instead of alternate compression and tension, as in a double acting piston.



These arrangements are in themselves well calculated to effect the required purposes, but in many cases they are accompanied by such drawbacks in details, that the effective result is not so good as from the old-fashioned double acting piston engine.

We this week illustrate a three-cylinder engine by Thomas C. Watts, which, whilst adhering to the advantages of multiple cylinders and single direction of strain, has many improvements in valve motions and details, which render the engine exceptionally likely to well fulfil its purpose.

One of the greatest drawbacks to these multiple cylinder engines has been the arrangement of valve gear, and the long port passages usually entailed thereby.

It may not be generally known what a great cause of waste the length of steam ports may become under high rates of expansion. In some cases the proportion of volume contained in the port passages to the whole volume of steam used in the cylinder is much larger than might be supposed, reaching from 30 per cent. to 50 per cent., according to the point of cut off in the cylinder. If the cut off is early the proportion is larger, and if the cut off is later the proportion is smaller.

The cone steam valves also, that have been so largely used for this class of engine, are very unsatisfactory in work, as they do not wear uniformly, and thus leak after a short period of use.

Mr. Watts' engine has its three cylinders arranged side by side, driving one to a three throw crank, in which the throws are discs shaped as cams, and which are utilized to operate the valves.

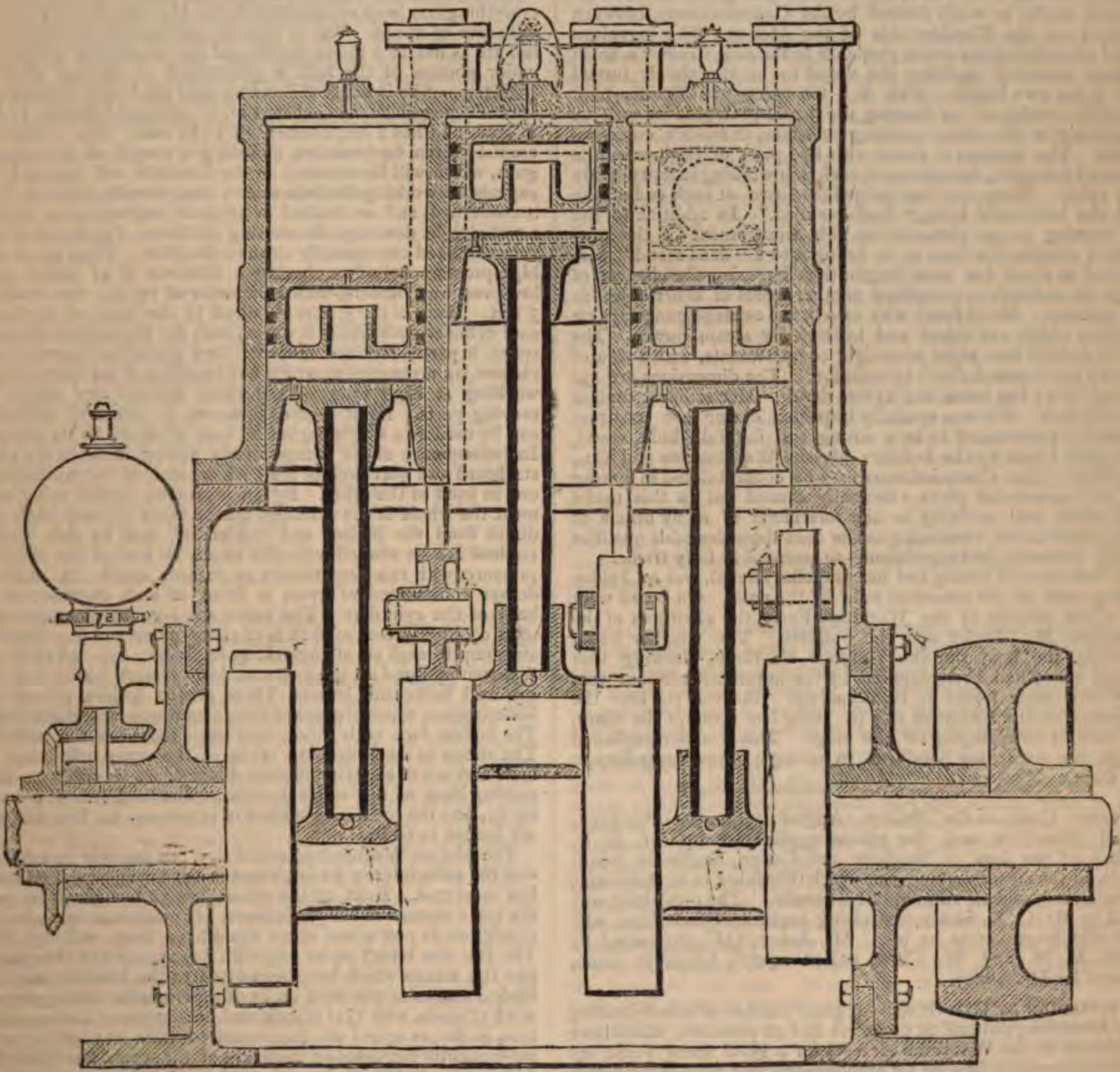
Each cylinder is supplied with its own slide piston valve, which is always kept, by the steam above it, pressing hard on the connections and cam gear, so that there is no possibility of its rattling under wear.

Each valve rod is worked by a working lever, which carries on it a roller, between its oscillating centre and the valve rod. This roller rests on the crank discs which are shaped as cams to drive the valve gear as required. A cam motion of this kind, with the valve kept down, bearing hard on it by the elastic pressure of steam above, makes a very prompt valve gear, very sharp in its cut off. The pistons are very long to give a good bearing, packed with three spring rings and with a gudgeon pin through their centre, on which the small end of the connecting rod takes its bearing.

In the arrangement of the pistons and connecting-rods, there is again an excellent improvement in detail, in the way in which a supply of oil can be introduced to the crank bearing. This is the most troublesome of all the bearings in any engines of which the crank is boxed in and covered up as in this case. A lubricator is fixed at the top of the cylinder, and a grease hole is drilled through the top of the piston, so as to allow the oil to drip slowly through into a hollow cup on the end of the connecting-rod brass. The oil from thence passes down the hollow connecting-rod to the brass bearing below, which it thus effectually lubricates.

The valves can be regulated automatically to vary the cut off from $\frac{1}{8}$ to $\frac{3}{8}$ of the stroke, always preserving their rapid movement and clean cut off.

This is effected by the following arrangement. All the valve-working levers are pivoted on a bar, which itself is capable of parallel movement by two small levers. These levers are moved by the action of the governor. The valve rollers are thus moved over on the cam, so as to cut off earlier or later as may be desired. The engine is thus automatically controlled by variable expansion. It should thus be very economical in working.



NEW WOODSIDE LUGGAGE BOAT.

About eighteen months ago the Birkenhead Commissioners resolved to build a new goods steamer for their increasing goods traffic at Woodside. It was proposed by some members of the board to take the saloon off one of the large passenger boats and lighten her, so as bring the deck on the same level as the stages, thereby admitting the free ingress and egress of wheeled vehicles without unyoking the horses, thus saving time, labour, and expense, and greatly reducing the risk. This proposal, however, was not generally approved, and the Oxton, which is the name of the new steamer, was built. This vessel, although 20 feet shorter and 5 feet less in breadth, is actually a more commodious vessel for the purpose than a larger passenger steamer would have been. Being fitted with screw propellers, the cumbrous paddle-boxes are dispensed with, giving, among other advantages, considerably increased deck space, and increased facilities for working the traffic, while the gangways are placed nearer midships, where there is less motion. The deck of the steamer is level with the landing stages, and wheeled vehicles of every description can therefore be driven on board and proceed from end to end of the steamer as though it were a continuation of the stages. This will go far to develope the goods traffic, so much desired by the Commissioners, between Liverpool and the Cheshire side of the Mersey. The ingenious method of applying the screw propeller to the new steamer is novel and most essential, enabling the vessel to be completely turned round in her own length. This is a most important desideratum, in handily coming to or leaving the landing stages, as well as manœuvring in the river, avoiding collisions, in sudden emergencies, &c. The steamer is fitted with two pairs of engines on the compound principle, disconnected, each pair working independently of the other. There are four propellors—two at each end of the vessel, the boat itself being "double-ended." In addition to the quick turning power obtained by this arrangement of the propellors, it enables the boat to be brought to a "dead stand" from full speed in about her own length, thus lessening the chances of damage on suddenly approaching another vessel or other object in foggy weather. She is fitted with two broad carriage gangways on each side, which are raised and lowered by steam power. The vessel is divided into eight watertight compartments, with a view of rendering her "unsinkable" by collision. The dimensions are 130 feet long by 45 feet beam and 14 feet depth. Her ordinary draft is 7 feet 6 inches. She was specially inspected during her construction, and is pronounced to be a strong and faithfully built vessel, doing great credit to the builders, Messrs. Wm. Simons and Co., of Renfrew. The Commissioners may be congratulated in having their well-considered plans effectually carried out in this useful vessel, which will probably be the forerunner of many others of similar construction, combining as she does those desirable qualities —safety, economy, and expedition—so essential in ferry traffic.

The new steamer having had her propeller altered, was on Friday morning tried at the measured mile in the river. On board were some of the officials of the Woodside Ferry, the chairman of the Committee, Mr. Taylor and the builders. The weather being favourable, the boat ran the distance six times, showing that sufficient speed had been acquired by the improvements that were a short time since found to be necessary. She was put into the embayment on the Liverpool side (it being low water at the time), was tested as to springing off the stage. This was accomplished through her exceeding handiness in having 4 screw propellers to work them.

Patent Case.—On Friday, August 15th, the Attorney-General refused to seal the patent applied for by Mr. T. E. Brigham, of the firm of Brigham and Cowan, Engineers, South Shields, for the steam steering gear which they fitted to ss. Ashburne, of Sunderland, and ss. Amoor, of Newcastle. The opposition was lodged by Mr. C. R. Simey, consulting engineer, Sunderland, who claims the invention to be his. Mr. Aslow, Q.C., instructed by Messrs. A. M. and W. Clark, patent agents, Chancery Lane, appeared for Mr. Simey.

Utilisation of Old Guns.—A great number of breech-loading guns, Armstrong pattern, 25 pounders and 40 pounders, which have lain unused in the Woolwich Arsenal for a good many years, are now being brought forward for employment, and after examination and any necessary repairs they will be mounted in Cork Harbour and such-like places for coast defence. Many of these guns have never left the arsenal since they were made, and the remainder, though classed as repairable, have been scarcely thought of for ten years past, until the reaction in favour of breech-loaders has once more brought them into notice.

HER MAJESTY'S SHIP "MERCURY."

The new steel despatch vessel Mercury, which is being completed for sea at Portsmouth, was tried under way on three days, the first day being devoted to power and the others to speed. The engines were in charge of Mr. Warrener, the contractor, Messrs. Maudslay & Co., being further represented by Messrs. Duncan and Field, members of the firm; Mr. J. Wright, Engineer in Chief, and Mr. J. Oliver, Engineer Inspecting Officer, watched the trial on the part of the Admiralty; and there were also present Inspector of Machinery Iceley, from the steam Reserve, and Mr. Durston, from the Dockyard. Commander Dowding commanded the ship.

In material, construction and dimensions, and in the power and description of her machinery, the Mercury is a sister ship to the steel despatch vessel Iris, which has completed her trials at Portsmouth and is ready for commissioning. The only difference has reference to appearance, and is a mere matter of detail of no practical importance. The Iris has an overhanging bow, a figure-head being placed on what is termed the "knee of head," while the Mercury has a perfectly straight stem. She was built at Pembroke from Mr. Barnaby's designs, and is engined by Messrs. Maudslay, Sons & Field. As was the case with the sister ship, everything has been surrendered in the Mercury in order to secure a high rate of speed. She is entirely unprotected, her entrance and run are as fine as a racing yacht, and her machinery, which fills the major portion of the hull, is guaranteed to develop 7,000 on her trial trip. She is built of Landore mild steel, and measures 300 ft. between perpendiculars, 46 ft. 1 in. in extreme breadth, 61 ft. 3 in. in hold, and has a displacement of 3,750 tons. Her armament will consist of ten 64-pounders, including a couple of revolving chase guns, which will be mounted on the forecastle and the poop. The engines for working the twin screws are a novelty, so far as the Navy is concerned, and are located in separate engine-rooms, divided by a water-tight doorway, the starting platforms of each pair of engines being situated conveniently close to the door. There are in all four high-pressure cylinders, having a diameter of 41 inches, and four low-pressure cylinders, with a diameter of 75 in., the stroke being 3 feet. Each of the former is bolted to the front of the low-pressure cylinder with which it works, and, for the sake of economising space, is partly recessed into it. One piston rod carries the two pistons, an arrangement which has been found the best adapted for working at high rates of expansion without any jolting of the moving parts. Each engine, however, is complete in itself, and can be used as a single engine in case of injury to its companion. In consequence of the comparatively narrow beam of the ship, the starboard and port engines are both erected on the middle line, the one in front of the other. By an ingenious duplex valve arrangement the whole of the cylinders can be made to draw their powers direct from the boilers and condensers, and by this means the engines can be worked with the steam as low as the atmospheric pressure, with excellent results as regards speed. A surface condenser constructed of brass is fitted in each engine-room at the back of the cylinders. The tubes are ⅝-in. in diameter, and the total cooling surface of each is of about 7,000 sq. ft. One vertical air-pump to each set of engines, 43 in. in diameter and 21 in. stroke, is driven by a rod off the foremost low-pressure piston-rod of each set, and bell-crank levers. There are 12 boilers, placed in two boiler-rooms, which are separated by a transverse watertight bulkhead. The boilers face each other, and are fired from the middle line. The sheets of the boilers are made of the same mild steel as the hull, and are of slightly different dimensions, in order to meet the varying lines of the ship's bottom. The total area of grate is 690 sq. ft., and the total tube surface is 15,900 sq. ft. The safety valves are loaded to 65 lb.

The trial on Wednesday, second day, can scarcely be said to possess the same interest for engineers as the experimental cruise of the Iris in 1877-8. Built on the same lines and engined in precisely the same manner as her predecessor, her performances under defined conditions of power and screw could have been well-nigh foretold. The Iris was tested under way with four varieties of twin propellers, and the screws which have been fitted to the Mercury are the four-bladed screws of the third series of experiments which gave a speed of 18·57 knots, with 7714 of indicated horse power. These results, it is true, so far as speed on the measured mile was concerned, were subsequently surpassed by the works of the special two-bladed screw, which gave 18·587 knots, with 7556 indicated horse-power, but the small improvement in speed under full power did not compensate for the increased vibration produced throughout the ship at all speeds except the maximum. No. 3-screws were, therefore, adopted, though, had time permitted, it was Mr. Wright's intention to continue the experiments. The diameter was 16 ft. 3½ in., while the pitch at the forward edge of the blades was 18 ft. 11½ in., at the after edge 20 ft.

11½ in., and the mean pitch as measured 19 ft. 11½ in. The disc area of the blades was ·288 of the whole disc. The blades were curved aft a little towards the tips, with a view of keeping the points rather further away from the A brackets, and of checking in some degree any centrifugal tendency of the water acted upon. The blades, which were constructed of gun-metal, were polished on both sides to reduce friction, and the edges were made sharp. The original bosses to which the blades were attached had each a conical tail-piece added. The vessel left the Tidal Basin on Tuesday, at half-past 7 o'clock, for a six hours' continuous full-power trial, and, after clearing the harbour, the engines were gradually worked up to full speed. The trial commenced at a quarter-past 8, a run being made down the Channel as far as St. Alban's Head. The force of the wind was from 3 to 4, and the direction abeam, the sea being quite smooth at the time. The draught was 15 ft. 8 in. forward and 20 ft. 6 in. aft, which was precisely the trim of the Iris during her experimental trips. At a preliminary run last week the mean pitch of the screw was fixed at 20 ft. 8 in., from which 7025 horse-power was realised. This was so far satisfactory, as the result showed 25 horses over the contract; but as the engines could not take all the steam that was generated and still better results were expected, the Mercury was subsequently docked and the pitch confined to 20 feet, which, again, was the pitch of the Iris's fans in the trial to which allusion has already been made. Singularly enough the engines on Tuesday could have taken more steam than could be obtained, the mean number of revolutions per minute having increased from 91 to 95. The following table gives the average results for every half hour during the six hours' official steaming :—

Steam in Boilers.	Vacuum.		Revolutions.		Indicated Power.		Total Ind. Horse Power.
	S.	P.	S.	P.	S.	P.	
63	27½	26¾	91·4	91·1	3500·68	3285·64	6786·32
65	27½	27¼	96·3	95·9	3744·70	3654·83	7396·83
64	27½	27¼	96·2	95·7	3619·10	3561·87	7180·97
64	27½	27¼	96·8	96·2	3604·46	3513·60	7118·06
62	27½	27½	96·4	95 9	3516·52	3557·42	7073·94
64	27½	27¼	97·7	96·2	3681·90	3586·70	7268·60
65	27½	27¼	97·6	96·7	3537·57	3616·08	7153·65
62	27¾	27¼	96·5	95·5	3481·49	3437·74	6919·23
60	27¾	26¾	95·5	97·4	3473 43	3489·43	6962·86
62	27¾	27	94·7	93·7	3429·12	3356·44	6785·56
58	27	27	93·7	92·2	3202·85	3137·45	6340·30
61	27	27¼	93·3	91·3	3380·97	3189·41	6570·33

These results were scarcely as satisfactory as at the preliminary trial, for while some of the observations showed that the engines were indicating 7396 and 7268·6 horses, the mean of the whole run gave a total indicated power of 6953·07 (that is, 3514·14 by the starboard and 3438·93 by the port engines), or a little below the guaranteed power. It will be seen that only on two occasions did the pressure in the boilers reach 65 lb., to which the safety-valves were loaded, while near the end of the trial the pressure fell as low as 58 lb. The cause of this was undoubtedly a failure in the supply of the smokeless coal which is generally used on steam trials and the necessity for resorting to North-country coal. By these means not only was the heat in the furnaces reduced, but the tubes partly choked by the thick smoke. The vacuum was exceedingly regular and satisfactory, the mean being 27·43 in. in the starboard, and 27·14 inches in the port condensers. The other means were :—Steam in starboard cylinders, 39·737 and 11·087 lb.; and in port cylinders, 39·341 and 10·85 lb.; revolutions, 95·5 starboard, and 94·5 port. A mean of a couple of runs on the mile in Stokes Bay gave a speed of 18·055 knots. These runs were made during the 10th and 11th half hours, when the steam-pressure was low, and when the feed to the boilers had become somewhat irregular. (The coal consumption averaged 2·35 lb. per indicated horse-power per hour.) The steam steering gear was found to act admirably, one man being able to steer the ship, where otherwise sixteen would be required to get the rudder over 15 degrees. By steam power the helm is put hard over 24 degrees. In the course of the day Mr. Wright took observations of the obstruction produced by the struts of the propeller tubes, which are not in the same plane with the water.

Although the Government officials were well satisfied with the working of the engines during the six hours' run, it was thought desirable to try the ship for speed on the measured mile, and thereby institute a comparison between her performances and those of the Iris. This trial was made on Thursday, and led to some astonishing results. The day was exceedingly boisterous, the wind having the force of between five and six, and the sea rather rough. The direction of the wind was west-south-west, and thus almost directly ahead and astern during the runs in Stokes Bay. Staff-Commander Parker was the officer in command, the other officials, with the exception of Mr. Wright, who was not present, being the same as on the previous day. After an hour's preliminary cantering, the ship was placed upon the mile with the following results, the boiler pressure being 64·75-lb.

	Revolutions.	I.H.P.	Knots.
First mile	97	7471·09	18·274
Second mile	98	7451·78	19·149
Third mile	97	7537·97	18·848
Fourth mile	98	7594 98	18·750

The mean of all the means gave the remarkable speed of 18·876 knots per hour, thereby beating the Iris (which realised a mean speed of 18·54 knots), and proving the Mercury to be the swiftest full-sized ship afloat in any navy in the world. Indeed, it is difficult to conceive of a ship of her size being driven through the water at the rate of close upon 22 miles an hour. The horse-power developed was also more than satisfactory, since the mean reached a total of 7513·95, which is greatly in excess of the contract, the mean revolutions per minute being 93·44 starboard and 97·26 port, and the average vacuum, 27·5 starboard and 27·12 inches port. The engines were subsequently worked with the jet injection, the results obtained being 4214·92 horse-power, 80 revolutions and a vacuum 25 and 23·5 inches. The exhaust into the low-pressure cylinders was next cut off, and all the eight cylinders worked direct from the boilers, as common engines, for the purpose of ascertaining with how low a pressure the machinery could be worked in action. The pressure in the boilers was reduced to 60 lb. above the atmosphere, and was then gradually further diminished to the atmospheric pressure. Under the latter conditions 60 revolutions were obtained. The engines were next stopped, and started again at 5½ lb. above the atmospheric pressure; and were afterwards worked at full power to bring the ship into harbour. Before the close of the trial, however, the engines were stopped, the starboard engine in 34 seconds and the port in 37 seconds; being stopped they were started ahead in 12 seconds and 10 seconds respectively; and going astern they were started ahead in 17 seconds and 10 seconds. The whole of the second day's steaming proved a gratifying success.

It is proposed at Portsmouth to convert a number of second class torpedo boats into patrol vessels, by unshipping the impulse tube forward and fitting a Nordenfeldt gun in its place. This new and fearful weapon consists of four barrels, each an inch in calibre, ranged in line, and is capable of penetrating an inch plate at a range of 1,300 yards. It is loaded at the breech by means of a lever.

CLEARING HARBOURS OF TORPEDOES, &c.—A trial has been made on board the Bloodhound, gunboat, at Portsmouth, of a new means which has been suggested by Capt. Arthur, while in command of the Vernon, for clearing harbours of sunken mines and fixed torpedoes. At present the method adopted is to destroy the engines by countermining or by the hazardous process of "creeping." This is effected by boats being sent out to grapple for the cable connections, and then severing them by small charges of gun-cotton. This mode, however, is very slow. The new method of opening a free channel for the passage of ships, as tried in the Bloodhound, consists in running out a couple of booms, 30 feet in length from the bows of the ship. Across the submerged ends is fixed a horizontal beam 38 feet in length, having a zig-zag arrangement of iron rods in the form of a W; the idea being that the open space of each V of the series, as it is pushed through the water, will enclose the torpedo fastenings or connections, and lead them to the point at the bottom, which is fitted with a scissor contrivance, the blades of which are worked by levers in connection with the capstan on board. The beam searcher has a sweep of 50 feet, and the mechanism is capable of cutting through the strongest electric cable. A net, which is supported from the whiskers of the bowsprit receive the liberated torpedo, and prevents it exploding against the operating craft. The trial proved a great success.

THE KRUPP GUN EXPERIMENTS.

THE following review, by the able special correspondent of *The Times*, of the results attained by the Krupp guns during the four days' experiments at Meppen, will be read with interest. After describing the practice ground and its arrangements, he proceeds to the examination of the guns themselves, describing them as all, to some extent, of the same type. They are all breech-loaders, they are all rifled by a number of shallow grooves separated by very narrow lands, and the projectiles are all made to take the rifling by the same means. Each of these three points requires a brief separate consideration. With regard to muzzle-loading, it may be said that Herr Krupp has now for some long time entirely discarded it from his system. While feeling his way to do this he tried in succession several different ways of closing the breech, and that on which he has at last rested seems to leave little to be desired. The principle is that a block of steel having a flat side towards the bore of the gun, and a cylindrical side slightly tapering so as to be a portion of a much elongated cone rather than of a cylinder towards the rear, slides in an opening of similar shape, which is at right angles to the bore, and immediately in front of the rear sights. When this block of steel, which may be called the breech-plug, is withdrawn as far as it will go, it leaves the tube of the gun free; and when it is replaced, so as accurately to fill the cavity in which it is received, the breech is perfectly closed. In small guns the breech-plug is moved to and fro by hand, and in large ones by the aid of a screw; and in all it is finally driven home and fixed by a second screw, which is received into grooves cut in the rear. The mechanism of this second screw differs a little according to the size of the gun, but the differences are only of detail, and it would be difficult to render them intelligible without the aid of diagrams. In all the guns the fire of the fuse reaches the powder in the rear; but in the larger calibres the vent is directly axial, while in the smaller ones it is carried obliquely upwards. The tube for the reception of the fuse contains a platinum ball, which permits the fire to pass it to reach the powder, but which is itself blown back by the discharge so as to close the vent. It may be doubted whether this arrangement might not be improved; for there were several misfires during the trials, and it seems probable that the platinum ball might become jammed, or might be hindered from moving by the sticky character of some of the products of combustion, and might thus serve to protect the powder from ignition. The point is one of very small importance as regards the breech-loading principle, concerning which it may be said that the Krupp system affords a perfect protection against the escape of smoke to the rear. The guns were watched with the closest attention, and it was remarked that there was not as much smoke from any discharge as would be produced by one cigar, and that men working such guns in a turret would not experience the smallest inconvenience. The loading was accomplished with great speed and readiness, and the method, while it secures all the manifold advantages of breech-loading, seems to avoid most of the inconveniences which have often been attributed to it. The system of rifling will, perhaps, be best displayed by the following table, which gives the whole series of guns shown at Meppen, with one exception presently to be noticed:—

Calibre of gun in millimetres.	Number of grooves.	Width of grooves in millimetres.	Depth of grooves in millimetres.	Width of lands in millimetres.
400	90	9·45	2	4·5
355	80	not stated	2	4·5
280	64	9·25	1·75	4·5
240	54	not stated	1·5	4
209·3	50	9·15	1·5	4
155	36	not stated	not stated	not stated
149·1	36	9·5	1·5	3·5
105	32	6·8	1·25	3·5
96	32	6·4	1	3
87	24	8·4	1·25	3

For those who are not accustomed to think in French measures, it may be useful to say that 9 millimetres are almost exactly the third of an inch, so that the rifling of the big guns is by grooves $\frac{1}{3}$ of an inch wide and $\frac{1}{13}$th of an inch deep, separated by lands $\frac{1}{6}$th of an inch wide. The rifling of the smaller guns is by grooves, about a quarter of an inch wide and from $\frac{1}{20}$th to $\frac{1}{30}$th of an inch deep, separated by lands $\frac{1}{8}$ of an inch wide. The exception already mentioned is in the case of a mortar, which has 150 millimetres of calibre, and is rifled by only 18 grooves, each 22 millimetres wide and $1\frac{1}{2}$ deep, separated by lands 4 millimetres wide. The greater width of the grooves in this case is, no doubt, connected with the shortness of the tube, which is only $\frac{1}{5}$th the length of that of other guns of the same calibre. The numerous shallow grooves, closely set together, must really be regarded as converting the inner surface of the gun into a polygon, and bear scarcely any resemblance to the deeper grooves, few in number, and separated by lands much wider than themselves, which are used in the English artillery. The pitch of the rifling in the different guns is various, and is exhibited in the following table:—

No.	Calibre of gun in millimetres.	Length of bore in front of breech-plug, in millimetres.	Pitch of rifling in calibres.	Pitch in length of complete turn in metres.	Length of projectile in diameters.
1	400	8711	1 in 45	18·0	2·8
2	355	7740	1 ,, 45	16·0	2 8
3	280	2525	1 ,, 35	9·8	2·8
4	240	5410	1 ,, 45	10·8	2·8
5	209	2032	1 ,, 35	7·3	2·8
6	155	not stated	1 ,, 45	not stated	not stated
7	150	775	1 ,, 15	2·24	2·8
8	150	3780	1 ,, 25	3·73	3·5 or 4·0
9	150	3435	1 ,, 45	6·71	2·5
10	105	2574	1 ,, 25	2 63	3·5
11	96	2260	1 ,, 25	2·4	3·4
12	87	4085	1 ,, 30	2·61	3·7

From this it would appear as if no very definite rule had been followed, and as if the question of pitch could hardly be looked upon as decided; but it is manifest that there is a tendency in the direction of the principle long ago laid down by Sir Joseph Whitworth—that increased pitch is necessary in order to give steadiness of flight to increased length of projectile. With projectiles of less than three diameters long, the pitch, except in the case of No. 7, the mortar, does not exceed one turn in the length of 35 calibres; but as soon as, in No. 7, we have a projectile three and a half or four diameters long, we find a rifling of one turn in the length of 25 calibres. In the case of the mortar, it is manifest that the high pitch of one turn in 15 calibres is required in order to compensate for the short length of bore along which the grooving can effect the flight of the shell. The rifling is made to take effect, in every case, upon a band of copper which encircles the projectile near its base, being forced by pressure into a groove undercut for its reception. The band projects from the surface of the projectile sufficiently to arrest the latter at the commencement of the rifling; and the copper is marked by three or four circumferential grooves, intended to diminish its resistance to the impulse of the powder. This band fulfils also the purpose of a gas-check, and renders any appliance of that kind unnecessary. In some projectiles there is a second band, at the base of the anterior pyramidal portion, which just fits the calibre of the lands, and which, without entering the grooves, serves to steady the projectile in its course along the bore. In others, the second band is not employed, but the diameter of the projectile itself is a little increased in the same situation, so as to fulfil a similar purpose.

Turning next to the general results attained by the Krupp system of construction, they may be very briefly expressed. The Krupp guns have exhibited qualities, both as regards accuracy and power which have never yet been approached by any service artillery in the world. Of eight shots fired from the 40 centimetre, or 16 in., or 71 ton gun, at a target 2,700 yards distant, the centres were all included within a parallelogram 5 ft. 8 in. wide and 19 in. high. In other words, from the centre of this parallelogram the extreme horizontal deviation was only 2 ft. 10 in., and the extreme vertical deviation was only $9\frac{1}{2}$ in. In another trial of the same gun on a subsequent day, at the same target, the extreme horizontal deviation, in five shots, was 3 ft. 9 in., and the extreme vertical deviation was only 10 in. In firing at a dummy battery on the 5th, with shell from the 10 centimetre gun, at a distance of 2180 yards, six shots out of the ten fell within a horizontal parallelogram 2 yards wide and 8 yards long, and the remainder were only a little outside these limits. When we come to the consideration of power, the results are still more striking. The 24 centimetre gun, firing a chilled steel shell, weighing 352 lbs. with 165 lbs. of powder, gave to its projectile an initial velocity of 1910 ft. per second, and a total energy of 8775 foot tons, or of 287 foot tons for every inch of its circumference. The same gun drove a similar shell through 20 in. of iron plating, and the projectile travelled 3250 ft. afterwards. The 24 centimetre gun weighs 18 tons, and the English 38 ton gun is capable of exerting about the same amount of power. The latter, firing a projectile weighing 812 lb., with 200 lb. of powder, developed 340 foot tons of energy per inch of circumference, and the shot passed through three plates of 6½ in. in thickness, and bent and broke a fourth, but failed to pierce it. It would probably not be unfair to say, therefore, that the Krupp guns are about equal in power of penetration to Woolwich guns of twice their weight. This is a far more important element in the case than their superior accuracy, because the accuracy of a gun in actual warfare must always be more dependent upon the manner in which it is laid and worked than upon its actual qualities when laid accurately for known distances. The energy imparted to a projectile, on the other hand, is a matter which faulty working can scarcely affect, and which must in great measure determine the actual value and the destructive power of the weapon. If we inquire how the better results are obtained the answer must probably take note of a variety of conditions. In the first place, the guns are thoroughly constructed of steel, so that they will bear, relatively to weight, much greater powder charges than our own, and being longer in proportion to calibre, they have time and space in which to burn these heavy charges advantageously. Something may be due to the powder itself, which is pressed into blocks or prisms of about a cubic inch in size, and of hexagonal outline, the prisms being perforated with either one hole or with seven holes, according to the rapidity of combustion which is desired. These prisms are packed rather loosely into bags, which themselves have necessarily an hexagonal shape, and which, therefore, leave a considerable air-space between their sides and the powder chamber, as well as in the perforations of the prisms and between their adjacent surfaces. It is calculated that there may be as much as 40 per cent. of air-space in and around a cartridge in the chamber of a gun; and rapidity of combustion, when desired, is further promoted by diminished compression of the powder, which is made of 1·75 specific gravity for large guns, but of only 1·64 for smaller ones. For the smallest guns a coarse-grained powder is used instead of the prisms. On the whole, it may fairly be said that every precaution which science can suggest is employed to obtain such a rate and kind of combustion as may apply the greatest amount of force to the projectile, with the smallest strain upon the chamber of the gun; and there can be no doubt that comparatively slow burning of the powder, with such a length of bore as may allow this combustion to be complete, are highly important factors in the attainment of the desired result. For the attainment of length of bore, it must be remembered, breech-loading is absolutely necessary, because, especially in turrets, guns of the length made by Herr Krupp could not without great inconvenience be run in for the purpose of loading them.

The use of steel as a material is regarded as one of the most essential conditions of success; and although the recent destructive explosion of a Krupp gun has cast some doubt upon the accuracy of this opinion, we must wait until all the facts of the disaster have been made known before we attempt to deduce from it inferences which these facts possibly may not support. There can be no question that steel, *cæteris paribus*, is stronger than iron, and especially there can be none that it is stronger than those wrought coils "glued together by slag" in which the authorities of Woolwich so much delight. It is at least safe to affirm that, where a steel gun bursts an iron gun, a gun compounded of iron and steel, would have burst still more destructively; and with this single premise, the lessons to be gathered from the recent accident must be left until our information about it is more complete. It is at least certain that the explosion has in no way shaken Herr Krupp's confidence in the system of which he has been the founder. By his kindness I have been permitted to spend a day in his works at Essen, and to see the guns in every stage of manufacture. It is said that they are made from "crucible" steel, as distinguished from that obtained by either the Bessemer or the Siemens-Martin process; but the word crucible is not used in its original sense in relation to the steel manufacture, and only signifies that the ingredients employed, whatever they may be, are melted together in crucibles before being cast into ingots. Herr Krupp objects to the Whitworth system of compression as a means of obliterating the air cavities in steel, and asserts that by this means the cavities are only closed; that no real union occurs between the opposed sides; and that they are still sources of weakness. He states that by carefully bringing the contents of all the crucibles to the same precise degree of fluidity the formation of air cavities may be entirely prevented in the lower two-thirds of each ingot; and he is content to sacrifice the upper third, or at least to cut it off and to apply it to less important uses, for the sake of obtaining the necessary quantity of his material. His large castings are conducted with military precision, and as the crucibles are comparatively small, as many as 1,200 men are sometimes employed in the production of a single ingot. The completed ingot is hammered to the necessary tenacity, pressure forging not being employed, and then that which is destined to form part of the inner tube of a gun is bored to form the calibre. The central steel tube of the Woolwich guns is also bored; but it is bored by a wasteful and destructive process, which cuts into fragments all that is removed, while Herr Krupp, by means of a cylindrical boring tool, cuts out of his ingot a solid core of steel, from which a smaller gun may be made, or which may be applied to a variety of useful purposes. More than this, when he made muzzle-loading guns he discovered a method, which he has kept secret, of cutting off this core within its surrounding tube, so as to leave the latter with its closed end perfectly homogeneous with its sides. For breech-loaders, a complete perforation being required, this method of boring is not practised; but the core-cutting alone secures a great economy of manufacture when compared with the English method. The inner tube is sometimes made complete in a single length, but in the longer guns it is made in two lengths or more; and over the inner tube, when completed, outer tubes of steel are superimposed by shrinking, in number and thickness regulated by the calibre, and by the probable powder strain to which the gun will be exposed. A marked difference between the Essen and the Woolwich construction depends upon the way in which, in the former, the outer tubes are tapered off towards the muzzle; while in the latter they terminate in more or less abrupt shoulders, which produce sudden diminutions of strength at intervals along the bore. The work of rifling and of finishing presents no peculiarities which call for especial mention—except that in every department of the factory there are evidences of the constant supervision of an organising mind of the highest order. The division of labour, the economy of time and of material, and the complete adaptation of means to ends, are carried to an extent which is in few places equalled, and probably nowhere surpassed. A notable example of this is furnished by the arrangements for the proof of guns, an operation which is conducted in pits sunk for the purpose, so covered in and protected that there is no danger from either bursting or recoil, and so close to the factory that no time is wasted in conveying the guns from place to place.

The works at Essen are so extensive, covering nearly 1400 acres, and having nearly 300 acres of roofing, that it is impossible for a visitor either to inspect them thoroughly or to write an adequate account of them; but as regards the artillery department, perhaps their most interesting feature is a museum containing all the successive improvement which have been introduced, or attempts at improvement which have been made in the manufacture of guns and projectiles. Successive forms of rifling, of breech plug, and of gun, are here arranged in chronological order; and the history of the past is displayed side by side with the facts of the present. The whole establishment, from one end to the other, teaches what great results may be produced by the judicious encouragement of private skill and enterprise; and excites the gravest doubts whether our own system of Government factories, with their inevitable concomitants of officialism and of jealousy of inventors, may not tend to place us in a position of serious disadvantage whenever we are called upon to engage in hostilities with adversaries of force at all equal to our own. The recurrence of history must in time bring about such a condition; and the recent gun-trials at Meppen may well induce us to set our house in order, and to reconsider, with a view to radically reforming, the system under which we have been so long content to live, and which has left us, in spite of the liberal expenditure of the resources of a great nation, altogether outstripped by the results of a private manufacturer. The artillery officers present were unanimous in their admiration of the gunnery; and it is probable that the establishment at Essen, which has already supplied more than 20,000 cannon to various Governments, will largely increase that number in consequence of the proofs which have now been afforded of the unapproached excellence of its manufactures.

THE Clyde shipbuilding returns for August show a slight improvement as compared with last month; the tonnage of the vessels launched was 10,000 tons.

Review.

The Sailor's Sea-book. (Weale's Rudimentary Series). By Jas. Greenwood, B.A., and published by Messrs. Crosby, Lockwood, & Co. This very useful series of manuals abounds in cheap and well written treatises on most scientific and practical subjects, and the one now before us, called the "Sailor's Sea-book," is conceived and written in a most instructive and lucid style. This issue is new, revised, and much enlarged by W. H. Rosser, so as to make the volume complete enough to enable a yachtsman to take his vessel round the world, or to converse by the established codes of signals with any vessel he may meet.

The object of this book is not to place in the hands of a practical seaman or amateur yachtsman a scientific exposition of navigation, very clever perhaps but very confusing, useless to the practical sea-goer, but to give him in as simple a manner as possible just as little navigation as will enable him to keep his dead reckoning with accuracy, and to find the ship's position by observation. It is to be feared that too much space is given in many books on this subject to the method by projection, a mode of working never adopted by practical seamen, and further all the possible examples and branches of the subject only serve to confuse and to prevent the practical man from learning anything perfectly. By the aid of traverse tables the seaman may get his position by dead reckoning as treated of in Part I. By the aid of the other tables, logarithms, &c., and the Nautical Almanac, he finds his position by observation, in the simple manner with sextant and chronometer as shown in Part II.

If he is a careful navigator he may also find how to ascertain the error of the compass. An important feature in this edition is a full detached account of the International Code of Signals, with coloured plates of the different flags, also details of semaphore telegraphy and boat signalling by the use of sailors, which would no doubt prove of very great value in a seaman's life. A short essay on the Law of Storms by Mr. Chas. Tomlinson, is exceedingly interesting, and shows a great acquaintance with the subject.

The work closes with a dictionary of sea terms chiefly from Dana's "Seaman's Friend," which should prove very valuable to amateurs and prevent them showing their greenness when first taking charge of their own yacht. The whole work, in short, is essentially concise and practical, and full of information of the most useful kind.

Notes and Novelties.

Water-tight Doors on Board Ship.—The Admiralty, being of opinion that the practice in closing water-tight doors on board ships is too much of a routine duty at present, have issued a circular impressing on the commanding officers of her Majesty's ships fitted with water-tight doors the absolute necessity of paying strict attention to the practice of exercising the crews in closing these doors without any previous warning. Men are to be detailed in each ship whose duty, on the sound of the bugle, will be to proceed at all speed and close the doors to which they are appointed. This is to be a peremptory arrangement in all ships fitted with water-tight doors, and commanding officers are to take especial care that the number of men so detached shall be sufficient to provide for the casualties of sickness and other causes of absence. The crews are to be frequently practised in the exercise of shutting these doors without warning, and a record of such practice is to be inserted in the log.

One of the most interesting excursions available to the members of the Institution of Mechanical Engineers during their visit to Glasgow, was to Messrs. R. Napier and Sons' Shipbuilding Yard at Govan, where they witnessed the launch of a steel-built mail *steamer* named the Pizarro .This vessel and a sister ship nearly ready for launching, are built for the Pacific Steam Navigation Company, who are among the first of the Mail Companies to order steel-built ships, and likewise were the first to introduce the compound engine in their ships. The use of steel instead of iron in the construction of these vessels effects an increase of nearly 200 tons in the carrying power of each. The vessels are built to the highest class of the Liverpool Book, and the steel used has been subjected to rigid tests by the Liverpool surveyors. The Steel Company of Scotland mauufactured the steel by the Siemens-Martin process, and they may be congratulated upon the fact that, as we have been informed, in no single instance has any cracking or failure occurred in the working of material. These vessels are intended for the Pacific Company's West Coast Trade, and are built with an awning deck right, fore, and aft, the space between the main and awning decks being open at the sides. The officers' cabins and the saloon are on the main deck, but the greater part of it is fitted for carrying cattle. Above this, on the awning deck, are deck houses for the accommodation of 100 first-class passengers. The ships are 520 ft. long, 40 ft. broad. and 29 ft. 6 in. depth from awning deck to top of keel, and 3,400 tons of displacement. The engines are also made by Messrs. Napier, and are capable of developing upwards of 2,000 indicated horse-power. They are compound, inverted, having cylinders of 42 in. and 80 in. diameter, and 48 in. stroke. There are two boilers 13 ft. 6 in. in diameter by 17 ft. 6 in. long, with six furnaces in each, and one large annular superheater placed on top. The propeller is four-bladed, of steel, 17 ft. diameter, and 21 ft. 3 in. pitch.

Armour-Plate Experiments at Portsmouth.—Another highly satisfactory trial of a compound steel and iron armour-plate, intended for the protection of the turrets of the double turret ship, Inflexible, and manufactured by Messrs. Cammell and Co., of Sheffield, was made on board the Nettle, target ship, at Portsmouth. The test was of the same crucial character as on former occasions. Three rounds were fired from the 12 ton 9 in. gun at the plate at spots a foot apart, the range being 30 ft., the charge 50 lb., and the weight of the Palliser projectile 250-lb. The manufacture of this novel description of composite armour has been brought to so high a state of perfection, and the ordeal through which each plate is, for prudential reasons, required to pass previous to its acceptance by the Admiralty, is now attended with such uniform results, that the effect of each impact might be well-nigh foretold. The plate which was on this occasion subjected to trial was the fourth of the seven which had been manufactured by the Sheffield firm for the fore turret, and the extraordinary resistance offered to the penetration of of shot exhibited by the armour was so like that of previous plates, that with the alteration a few details of no importance, the description of one series of tests would apply to all. In every instance the projectile broke up and fell into a *mitraille* of splinters upon the gun-deck, the splash of the projectile upon the steel face of the shot opening a crack round the lower curvature of the impact, and filling up the indent with its own semi-molten metal. The first round struck 2 ft. 6 in. from the right edge of the target, and 4 ft. 7¾ in. from the bottom edge, producing three radial cracks of very regular form, one of which extended to the right edge. This was substantially the same as happened with No. 3 plate, and the diagram or picture taken after the first round on that occasion was almost a *fac-simile* of the appearance presented after the first round on Friday. The second shot struck 5½ in. to the right of the former point of impact and 23 in. below it. It opened several very fine hair cracks, which could just be observed underneath the film of paint with which the surface of the plate had been covered for photographic purposes. It also produced two cracks of no apparent depth at spots remote from the part hit, and which were probably caused by vibration. One of these extended to the right edge. The third round—always the most destructive because of its cumulative effects, and also in consequence, no doubt, of the movement set up in the molecules of the plate itself—hit 15½ in. below and 16 in. to the left of No. 1. This blow opened four more cracks, one extending from the point of impact to the left edge of the plate. The punishment in itself was slight, but the force of the blow developed some of the radial cracks produced by the previous rounds until they seem to have been produced by the last shot. Many of the cracks extended only slightly below the surface, and in no instance did any of them, when fully developed by subsequent impacts, sink further than the weld; and so far was the plate from being penetrated by the projectiles that there is reason to believe the indents did not proceed further than the iron backing which holds the steel together. These consecutive trials on board the Nettle are gradually proving that the use of steel in combination with iron for defensive armour will be the best means of keeping out shot and shell by breaking them up on impact.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers either from their intrinsic value or at being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.* Ed.]

To the Editor of the Marine Engineer.

Sir,—Seeing that you are devoting attention to the position of Marine Engineering, I venture to hope you will do your best to ventilate some of the grievances of the Engineers of her Majesty's Service. The subject of pay which you have been ventilating is, of course, all important; but, at the same time, social position and recognition amongst our fellow officers is as sore a subject with ourselves of the Navy.

It was all very well to bar us as a class from participation in messes, and an equal footing with our brother officers, when the engine power of Her Majesty's ships was but a small consideration, and the ranks of the Engineers were recruited from fitters who did not pretend to education or breeding. But now that a special training is provided in colleges and dockyards, only obtained by competitive examination, the class of Engineers will become what they ought universally to be, and now, I hope, very largely are, men of education and breeding, in every way qualified to rank and take their place as gentlemen. It is rather absurd, too, I think, when everything now-a-days on board our ironclads is worked by machinery, and the safety of the vessel is entirely dependent thereon both for fighting or running away, that our status of Engineer should not rank at least "pari passu" with that of our brother officers in the other branch of the service.

AN ENGINEER OF HER MAJESTY'S SERVICE.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* Marine Engineer *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—Ed.]

LAUNCHES (English).

Benona.—On July 29, a steamer, which has been building in the yard of the Local Shipbuilding Company, Sunderland, for Mr. Joseph Holt, of Liverpool, was launched. As the vessel left the ways she was christened by Mrs. William Burnyeat. The Benona is about 1,500 tons register, and her dimensions are:—Length over all, 249 feet, extreme breadth. 33 feet 3 inches, depth of hold, 17 feet 3 inches. She is intended for the Spanish ore trade, in which a sister vessel, the Benan, is engaged.

Leo.—On the 2nd August there was launched from the shipbuilding yard of Messrs. C. S. Swann and Co., at Wallsend, an iron screw steamer of the following dimensions:—Length between perpendiculars 285 feet, breadth moulded 35 feet, depth of hold 24 feet 6 inches, and which will carry about 2,830 tons. She has been built under special survey to class 100 A 1 at Lloyd's, has three decks, topgallant forecastle, and full poop. The vessel on leaving the ways was named the Leo by Miss Holmes, of Newcastle-on-Tyne.

Fountain's Abbey.—On the 6th August, at Jarrow-on-Tyne, a new steamer, named the Fountain's Abbey, was launched. She has been built by Messrs. Palmer and Co., for Messrs. Pyman, Watson and Co., of Newcastle. She measures 243 feet in length by 33 feet in breadth by 19 feet deep, moulded, and she will be classed 100 A1 at Lloyd's, the highest class, being built extra strong to render her suitable for the general carrying trade. The ceremony of naming the vessel was performed by Mrs. Tom Bell, of the firm of Pyman, Bell, & Co., of Newcastle.

Pouyer-Quertier. — On the 4th August there was launched from the shipbuilding yard of Messrs. C. Mitchell and Co., Low Walker, on the Tyne, a vessel of a novel description, built expressly as a telegraph cable ship, and named the Pouyer-Quertier, after the well-known French statesman, who also occupies the position of chairman of the telegraph company in whose service she is in future to be engaged as a maintaining steamer. The Pouyer-Quertier has been built to the order of Messrs. Siemens Bros., who have the contract for laying the cable of the "Compagnie Francaise du Telegraphe de Paris à New York," which is at present being placed between Brest, in France, and a point near New York. Although much smaller, the new vessel bears in many respects a resemblance to her predecessor, the well-known cable steamer Faraday, also built by Messrs. C. Mitchell and Co. for Messrs. Siemens Brothers about five years ago. Like the Faraday, the new steamer has twin screws, is fitted with a rudder at each end, and has bilge keels of a special description. There are on board two principal cable tanks, and sundry small supplementary tanks for coiling and stowing the different descriptions of cable. Her whole form and structure are unusually strong; and, although bearing the highest class both of the English Lloyd's and the French Veritas, she is even stronger than required by these societies. On the deck will be placed very powerful machinery of the latest and most improved description for the "laying" and "picking up" of cables. The machinery consists of a pair of compound surface-condensing engines, manufactured by Messrs. Thomas Clark and Co., of Elswick, including all the latest improvements in Marine engineering, and capable of propelling the vessel at a speed of 10 knots per hour on the most moderate consumption of fuel. Her dimensions are:—Length over all, 260 ft.; beam, 36 ft.; depth, 24 ft. 4 in.; and she will have a burthen of 1,800 tons. As the vessel left the ways, the christening ceremony was performed by Miss Siemens, daughter of M. Carl Siemens, who himself was present as the representative of his firm.

On Aug. 6, Messrs. M. Pearce and Co. launched from their iron shipbuilding yard, at Stockton-on-Tees, an iron screw steamer, of the following dimensions, viz.:—Length, 130 feet; beam, 22 feet; depth of hold, 10 feet 6 inches; and is of about 300 tons measurement O.M. This vessel is built for a London firm, and is intended for the deep-sea fishing trade. Her engines are from the establishment of Messrs. Blair & Co., Stockton, and are of 50 horse power nominal. She is the sixth vessel Messrs. Pearce & Co. have built for the same owners.

Laurium.—On the 2nd of August the Laurium, screw steamer, was launched from the yard of Messrs. Schlesinger, Davis & Co., Wallsend. She is 250 feet between perpendiculars, 33 feet in breadth, depth of hold 24 feet, and will be supplied with engines of 150 horse power. It is intended to introduce on board all the latest improvements in Naval architecture and Marine engineering. The vessel is intended for the Greek and Algerian trade, and will be commanded by Captain Dessaux.

Lucy.—A three-masted brigantine was recently launched from the ship-building yard of Messrs. W. Bayley & Sons, Hull. The vessel has been built for Messrs. Woodhead & Co., of Hull, for the foreign trade. The dimensions are:—111 feet keel and fore rake, 24 feet beam, and 12 feet 11 inches depth of hold. She is registered at 200 tons, will carry about 400 tons, and is classed A 1 at Lloyd's for 12 years. She is copper fastened and metalled. Miss Bayley performed the ceremony of naming her Lucy, after the daughter of her owners. Captain M'Caskill, late of the Thought, has been appointed to the command of the new vessel.

Steam Dredger.—On August 9 there was launched from the shipbuilding yard of Messrs. Osborne, Graham & Co., of Hylton-on-the-Wear an iron screw steam dredger, built for the Indian Government, and intended for service at Kurachee Harbour. The dredger was designed by Mr. W. F. Baths, C.E., London, to meet the requirements for dredging that harbour, and will be one of the most powerful and efficient dredgers afloat, being capable of dredging to a depth of 35 feet, and of raising 300 tons per hour. Briefly, her dimensions are as follows:—160 feet by 28 feet by 11 feet. She will be fitted with engines 65 nominal horse-power, by Messrs. Hawks, Crawshay, & Sons, of Gateshead-on-Tyne, which firm is also supplying the machinery required for dredging. As she left the ways she was christened by Miss Euphemia Graham.

Crane.—On August 16th the launch took place at the yard of Messrs. Joseph L. Thompson & Sons, North Sands, Sunderland, of the screw-steamer, Crane, which has been built to the order of Messrs. Dent & Co., of Blythe and Newcastle. The dimensions are as follows:—Length, 275 ft.; breadth, 35 ft.; depth of hold 24 ft; dead-weight capacity, 2,750 tons. The classification is 100 [illegible] the South Dock [illegible] power, [illegible] naming [illegible] Sunderland [illegible]

[illegible] screw steamer [illegible] Dock. [illegible] dimensions, viz.: [illegible] perpendiculars, [illegible] 22 ft. 0 in.; [illegible] tonnage [illegible]. She is classed [illegible] has been built under [illegible] stronger than their [illegible] bottom and tank [illegible] ballast, two iron decks, [illegible] accommodation of Captain and [illegible] topgallant forecastle [illegible] schooner. Her [illegible] principle, built by [illegible] Liverpool, and are of 150 [illegible] and 33 in. diameter, [illegible] working pressure of 75 lbs. [illegible] Messrs. Charles Hill & [illegible] intended for the American [illegible] she was christened the [illegible] by-the-Sea. This [illegible] Bristol City, launched [illegible]

[illegible] Raylton, Dixon and Co., [illegible] shipyard an iron screw [illegible] feet 0 inches depth of [illegible] tons, and a carrying [illegible] with all the latest improve[illegible] cargo. The engines are [illegible] and Sons, of Hartle[illegible] on leaving the stocks, [illegible] Messrs. Ed. Harris and Co., of [illegible] built for them by the same [illegible]

[illegible] Pearce and Co. launched from [illegible] Stockton-on-Tees, an iron screw [illegible] dimensions, viz.: Length between [illegible] breadth, 35 feet; depth of hold [illegible] This vessel has a gross tonnage [illegible] about 1,800 tons, has been [illegible] 100 A 1 at Lloyd's. She [illegible] to the bridge, the main, quarter [illegible] decks being of iron, the latter [illegible] She is rigged as a two-masted [illegible] topsail on the foremast, and [illegible] the lower masts are iron. She [illegible] water ballast, and with four double [illegible] other appliances for expedi[illegible] cargoes are of the newest and [illegible] engines, on the compound prin[illegible] and are from the works of Messrs. [illegible] This steamer is built for local [illegible] received the name of Norah, the [illegible] by Miss Balguy, of Cleve[illegible]

[illegible] Aug. the new screw-steamer Gua[illegible] service of the Portuguese Govern[illegible] and Shipbuilding Company, at [illegible] was launched. She was christened by [illegible] the Portuguese Minister.

[illegible] Aug. there was launched from Messrs. [illegible] screw-steamer, built to the order of Mr. [illegible] which is intended for the general [illegible] broad, and 18 feet 3 inches deep; her [illegible] tons. Her class is the highest at [illegible] up with all the latest improvements, [illegible] celebrated engines of 120 h. p. She [illegible] the ways by Mrs. Bowes.

[illegible] August 19th there was launched from the yard of [illegible] Readhead & Co., Lawe, South Shields, an iron screw steamer, named the Beta. The steamer is of the following dimensions:—249 ft. in length, 32 ft. 6 in. in breadth, and 17 ft. 6 in. depth of hold. She is classed 100 A 1 at Lloyd's, and is 1,308 tons gross register. The Beta is built on the raised quarter deck principle, has a long bridge amidships, and topgallant forecastle. She will be furnished with all the modern appliances for the speedy taking in and discharge of cargo. The Beta is built to the order of Messrs. Wilson, Taylor, and Partners, North Shields, and is intended for the general carrying trade. The ceremony of naming her was performed by Mrs. Viney, of North Shields.

Marengo.—On August 19th an addition to Messrs. Thomas Wilson, Sons, & Co.'s New York Line was launched from the yard of Earle's Shipbuilding and Engineering Company, at Hull. The new vessel, which is called the Marengo, is the 53rd that has been built by the same company for Messrs. Wilson. The following are her general particulars:—Length between perpendiculars, 300 ft.; breadth 37 ft.; depth of hold, 25 ft. 6in.; gross register tonnage, about 2,300. She is somewhat similar to the sister vessels, Lepanto, Otranto, Sorrento, Rialto, and Salerno, built by Earle's Company, but in many respects is an improvement on all those vessels, especially as regards the turtle backs, which are fitted fore and aft. The engines are 200 nominal horse-power, having cylinders 27 in. and 60½ in. diameter. These engines are what is commonly known as Holt's principle, being single-crank engines with the high-pressure cylinder on the top of the low-pressure cylinder.

Kate.—On the 20th August Messrs. T. Turnbull & Son launched from the Whitehall Shipyard, Whitby, a new screw steamship of the following dimensions:—Length, 273 ft. 6 in.; breadth, 34 ft. 6 in.; depth, 24 ft. 6 in.; dead-weight capacity about 2,800 tons. She had been built to class 100 A 1 at Lloyd's under special survey, and strengthened beyond the requirements of Lloyd's rules, and will be fitted with engines of 150 horse power by Blair & Co., Stockton-on-Tees. The vessel has been built to the order of Messrs. Jas. Gray & Co., Whitby, and is intended for the Atlantic and Indian trades, and on leaving the ways was named the Kate, by Miss Collis.

Gardenia.—On the 20th August there was launched from the yard of the Tyne Iron Shipbuilding Company, Willington Quay, a screw steamer of the following dimensions:—Length between perpendiculars, 280 ft.; breadth, 35 ft.; and depth of hold, 24 ft. 6 in. The steamer, which on leaving the ways was named the Gardenia, has been built to the order of Messrs. Joseph Robinson & Co., of North Shields, is fitted with a Liverpool house aft, monkey forecastle, and iron deck-house for engineers. She is classed 100 A 1 at Lloyd's, and has additional strength beyond Lloyd's requirements. The vessel is provided with all the modern appliances for the rapid shipment and delivery of cargo, has an iron main deck, tanks for water ballast in both holds, and four winches. Her carrying capacity is about 2,800 tons dead-weight, and she has been specially constructed for the Atlantic trades. The engines and boilers will be fitted by the North-Eastern Marine Engineering Company, Sunderland. The engines are 160-horse power nominal.

Longhirst.—On the 20th August, a screw steamer was launched from the yard of Messrs. Wigham, Richardson, and Co., Walker-on-the-Tyne. The steamer, which has been built to the order of Messrs. Elliott, Lowrie, and Dunford, Newcastle, is, between perpendiculars, 285 ft. long; breadth of beam, 36 ft.; and depth in hold, 24 ft. 6 in.; and will carry 3,000 tons dead-weight. Four powerful steam winches will be fitted on board for discharging cargo, and the vessel will be supplied with all modern improvements to secure economical working. The engines are being built by Messrs. R. W. Hawthorn, and will have cylinders 34½ and 64 in. diameter, with a stroke of 42 in. The vessel is intended for the American and general trades. Messrs. Elliott, Lowrie, and Dunford owned a smaller steamer named the Longhirst, which was lost last November, and the steamer which was now launched was also named the Longhirst, the ceremony of christening being performed by Mrs. Walton, wife of Mr. James Walton, Queen Street, Newcastle.

Vega.—On August 20 a large screw steamer was launched from the shipbuilding yard of Messrs. A. Leslie & Co., Hebbern, and was named the Vega by Mrs. A. Leslie. The vessel had been built for the Indian passenger trade, and is owned by the Star Line, Liverpool. Her length is 370 ft., 38½ feet beam, and 28½ ft. deep; carrying capacity, 3,000 tons. Her engines are being erected by Messrs. R. Stevenson & Co., Newcastle, and will be of 350-horse power. She will have accommodation for about 100 first-class passengers, and is expected to give an average speed of 12 knots,

Scotch.

Daisy.—On the 2nd August the Daisy (s), built by Messrs. T. B. Seath and Co., Rutherglen, for the Wallasey Local Board for the passenger traffic on the Mersey, was launched. Her length is 150 feet, 25 feet beam, and 10 feet 6 inches depth. She is divided into a large number of completely water-tight compartments, which renders her practically unsinkable, and she has unusually large staircases and gangways to ensure the speedy embarkation and disembarkation of passengers. She is a double-ended iron saloon steamer, with paddle-wheels, her deck saloon being 90 feet long, and 12 feet 6 inches broad inside.

Pizarro.—On the 5th August the Pizarro, the first of two steel screw steamships for the Pacific Steam Navigation Company, of Liverpool, was launched by Messrs. Robert Napier and Sons, Glasgow. She is a screw-steamer, 340 feet long by 40 feet broad, and 3,400 tons local displacement, and is specially arranged for the West Coast trade of the Pacific Steam Navigation Company, having all the necessary appliances for a general cargo in the hold, and fittings for carrying cattle on the main deck. This deck is covered right fore and aft by an awning deck, but is not closed in at the sides. On the awning decks are cabins for the accommodation of 100 first-class passengers. This vessel is fitted with engines made by her builders, and capable of developing upwards of 2,000 indicated horse-power; a large amount of sail power is also provided. The Pizarro and a sister vessel, which is nearly ready for launching, are built of Siemens-Martin steel, and the carrying power of each ship is thereby increased by nearly 200 tons deadweight.

Mountjoy.—On Aug. 6 a new hopper steamer of 500 tons, built and engined by Messrs. W. Simons & Co., was launched complete from their works, Renfrew. It is the property of the Harbour Commissioners of Londonderry, and is named Mountjoy. This vessel is built of the highest class, and is fitted with compound engines and steam appliances throughout.

Tweed.—On August 4 there was launched from the ship-building yard of Mr. James Roney, at Arbroath, a clipper schooner, of the following dimensions:—90 ft. long; breadth, 21 ft. 6 in.; depth of hold, 11 feet; and 109 tons register. She is classed A 1 at Lloyd's for 11 years. The vessel, as she left the ways, was named the Tweed by Miss Ferguson, of Glasgow. The Tweed has been built to the order of Mr. James C. King, of Glasgow, and will hail from that port. She is to be employed in the Newfoundland trade, and is to be commanded by Captain Cameron.

Ganymede.—On the 7th August the Ganymede, a steamer of 750 tons, built for Mr. Alfred Holt, of Liverpool, was launched by Messrs. John Scott & Co., Greenock. The dimensions of the Ganymede are:—Length, 175 ft.; breadth, 28 ft.; depth, 18 ft.

Cromartyshire.—On the 6th August the Cromartyshire, an iron sailing-ship, built to the order of Messrs. Thomas Law & Co., Glasgow., was launched from the ship-building yard by Messrs. Russell & Co., Port Glasgow. The following are her dimensions:—Length, 240 ft.; breadth of beam, 38 ft.; depth of hold, 22·9 ft.; and about 1,500 tons register. After her fittings are completed, she will load for San Francisco.

Comeragh.—On the 23rd July last there was launched by the London and Glasgow Shipbuilding Company a screw steamer of 1,000 tons and 200 horse power nominal. She will be fitted up in the finest style for a large number of first class passengers, and besides a steerage she has a barracks for soldiers. Has all the latest and most improved machinery, including Muir & Caldivell's steam steering gear. Rankines patent governor for marine engines. Steam starting gear, and internal parts of boilers are of steel.

Irish.

British Crown.—On the 2nd August the British Crown, an iron screw steamer, and sister ship to the British Empire, was launched at Belfast, by Messrs. Harland and Woolff. The new steamer is 410 feet long, and her gross register is about 3,000 tons. She will be fitted with four masts, and be supplied with compound engines. The christening ceremony was performed by Mrs. Spence, wife of Mr. Spence, of the firm of Richardson, Spence, and Co., of Liverpool. The British Crown has been built for the British Shipowners' Company.

Ulster.—On the 19th August the Ulster, a wooden barquentine was launched from the shipbuilding-yard of Messrs. A. M'Laine and Son, Belfast. She has been built for Messrs. W. P. Coleborn and Co., Liverpool, and classed 11 A1 at Lloyd's. Her dimensions are as follow:—Length of keel and foreake, 129 feet; breadth, 27 feet; depth, 12 feet 11 inches. She is 300 tons gross register. She will be fitted out in Belfast.

TRIAL TRIPS.

Madrid.—On the 26th July the screw steamer Madrid, built by Messrs. Wigham, Richardson, & Co., Low Walker, and intended for the Atlantic and Indiana trades, had her first trip to sea. The Madrid, which was constructed to the order of Messrs. Henry Bucknall & Sons, London, is under the command of Captain Matthew Garson, and is of the following dimensions:—Length, 280 ft.; beam, 35 ft.; hold 24 ft. 6 in. deep. She is capable of carrying about 3,000 tons, and has been engined by the Wallsend Engineering and Slipway Company, the engines being 33 in. and 66 in. in diameter, and the piston has a stroke of 39 in. The vessel, although classed at the highest requirements of Lloyd's Registry, is built greatly in excess of these, having about 100 tons more iron in her, which gives greatly increased longitudinal strength. She is fitted with all the modern appliances of a first class steamer, has four steam winches, four hatchways, deck fittings of iron of great strength, and the pumping appliances are capable of being worked by steam or hand power. The Madrid was taken several times over the measured mile, the first mile being accomplished in 5m. 3s., second in 5m. 40s., an average speed of 11 2-10ths per hour being obtained.

The Guiana.—On Saturday, the 26th of July, a very handsome new saloon paddle steamer named the Guiana left Blackwall with a select party on board, for her official trial trip at the measured mile on the Lower Hope. The vessel has been designed and built by Messrs. R. and H. Green, of Blackwall Yard, to the order of Hugh Sprosten, Esq., of the Sprosten Dock and Foundry, and intended for the mail service at Demerara. The following are the principal dimensions of the vessel. Length over all, 180 ft., extreme breadth, 19ft., depth moulded, 8 ft., or from top of floor to top of beam 7 ft. 6 in. She is about 240 tons gross register, and classed at Lloyds, A 1 for British Guiana and its rivers. She is fitted with a very large and handsome saloon on the main deck aft for the accommodation of 100 first-class passengers, with retiring cabin below, also a second-class passengers' cabin forward to accommodate 150 persons. She has a bridge deck over enginer and saloon for two-thirds the length of vessel, and fitted with pole mast and light rig which give her a yacht-like appearance. The engines are by Messrs. John Penn & Sons, of Greenwich, who have fitted the latest type of compound inclined engines with cylinders of 48in. and 27in. diameter, and 3·6in. stroke. They are 70 h.p. nominal, working easily up to 420 indicated, with 60lbs. of steam in the boilers, they, in a mean of four runs at the measured mile gave a speed of 13·17 knots working with the most remarkable smoothness. This high speed was obtained with very light consumption of fuel, about one-half of what would be required with engines of the old type. At the luncheon which followed the very successful runs at the measured mile the owner and friends expressed themselves as highly pleased with the vessel and the working of the machinery, and asked the guests to drink success to the saloon steamer Guiana.

This is the fourth steamer built by Messrs. R. & H. Green for the said company for passenger traffic on the rivers at Georgetown, Demerara.

Navigation.—The trial trip of the new screw steamer Navigation, which has been built to the order of Messrs. Dixon and Harris, of London, by Palmer's Ship-building and Iron Company, Limited, Jarrow, took place on the 30th July. The dimensions of the vessel are:—Length, 250 ft.; breadth, 34 ft.; depth, 22 ft.; carrying capacity, 2,200 tons. The engines (also built by Palmer's Company) are of 160 h. p. nominal, and work up to 850 h. p. The diameters of the cylinders are 30 in. and 60 in. respectively, the stroke of the piston being 39 in., and the number of revolutions 86 per minute, whilst the working pressure upon the boilers is 85lbs. to the square in. The engines are fitted with "Durham's velometer." The vessel has Emerson & Walker's direct steam windlass, which was tried in the presence of Messrs. Whetham and Eastcott, representatives of the patentees, and which proved very efficient in letting go the anchor and heaving it on board again in a very few minutes. The steamer is fitted with three steam winches and a donkey engine on deck. The vessel has been built under the superintendence of Mr. James Duncan, of London, (the representative of the owners). The vessel is intended for the general carrying trade, and her commander will be Capt. J. H. Williams. The speed of the steamer was tested over the measured mile off Whitley, and the mean runs with and against the tide were found to be nearly 11 knots an hour—the trial as a whole being highly satisfactory to every one concerned. During the trip the company partook of a capital luncheon, presided over (in the unavoidable absence of Mr. John Price, general manager) by Mr. R. Armstrong, manager of the shipyard department of Palmer's Shipbuilding and Iron Com-

A at Lloyd's, built under special survey, on the th[illegible]
the main and bridge decks being of iron. After [illegible]
vessel was taken to the South Dock to be fi[illegible]
compound surface-condensing engines, 180 nom[illegible]
by Mr. John Dickenson, of Sunderland. The [illegible]
the vessel Crane was performed by Miss Anni[illegible]
This vessel is intended for the Atlantic trade.

New York City.—On the 18th of Aug[illegible]
was launched from the building-yard of M[illegible]
& Co., South Stockton-on-Tees, of the [illegible]
—Length all over, 268 ft. 9 in.; len[illegible]
260 ft.; extreme breadth, 34 ft. 6 in[illegible]
depth moulded, 23 ft. 7 in.; tonna[illegible]
gross (N.M.), 1,725 tons; carryin[illegible]
100 A 1 at Lloyd's as a three-deck [illegible]
special survey, but is throughou[illegible]
requirements for classification. [illegible]
hold capable of containing 5[illegible]
short full poop fitted up fo[illegible]
Officers, bridge-house for [illegible]
for the Crew and Firem[illegible]
engines are on the co[illegible]
Messrs. Thomas Richar[illegible]
horse power nominal, [illegible]
the length of stroke [illegible]
The vessel has been [illegible]
Sons, of Bristol [illegible]
trade. As the [illegible]
New York Cit[illegible]
steamer is a si[illegible]
by the above [illegible]

Dalbeatt[illegible]
of Middle[illegible]
steamer, 2[illegible]
hold, hav[illegible]
capacit[illegible]
ments f[illegible]
of 120[illegible]
pool. [illegible]
has [illegible]
M[illegible]
l[illegible]

[illegible] Bedale,
[illegible] Scarborough,
[illegible] Shields, was
[illegible] unfavourable,
[illegible] was blowing
[illegible] After get-
[illegible] Marsden, but her
[illegible] The engines,
[illegible] gave entire satisfac-
[illegible] Bedale will be com-
[illegible] The following
[illegible] th, 114 ft.; depth of
[illegible] is 1,[illegible]50 tons, and she
[illegible] by Messrs. Readhead
[illegible] surface condensing engines.
[illegible] and have cylinders of 27½
[illegible] The steamer is supplied
[illegible] the latest improvements.

[illegible] Patents connected with [illegible] Ship Construction, and [illegible] Appliances for use in Ships, from [illegible] August 21st, 1879.

[illegible] 23, *Rood Lane, Fenchurch* [illegible] *London, E.C.*

[illegible] temperature in ships' holds, cabins, [illegible] Coleman. 2970.
[illegible] and meters, S. C. Davidson. 2978.
[illegible] steam (communication Baron Seilliere and [illegible] M Clarke. 2985.
[illegible] and G. H. Wall. 2998.
[illegible] W. Moseley. 3001.
[illegible] communication A. Gillitzer), W. L. Wise. 3004.
[illegible] (communication J. Patrick), F. Wirth. [illegible]
[illegible] A. W. Shephead. 3024.
[illegible] Mitchell and J. D. Cocks. 3035.
[illegible] C. S. de Bay. 3041.
[illegible] J. Hodgkinson. 3042.
[illegible] 3044.
[illegible] extinguishers for ships, A. M. Granger. 3050.
[illegible] sheets of fore and aft sails to the deck, R. [illegible] 3083.
[illegible] determine elevation of guns, M. Blakiston. 3088.
[illegible] D. Thomas. 3110.
[illegible] valves, F. T. Smith. 312[illegible].
[illegible] communication between vessels, S. [illegible] W. C. [illegible] amson, S. E. Philips. [illegible]
Steam generator, T. Russell. [illegible]
[illegible] winches, J. D. Na[illegible] [illegible]
[illegible] boilers, H. Hargreaves. [illegible]
[illegible] indicator and [illegible] J. R. A[illegible] 315[illegible].
[illegible] magnetising ships, E. H. H[illegible]
[illegible] gear, J. R. Jeffries. [illegible]
Steering apparatus, W. [illegible]
[illegible] cut-off, T. B. L[illegible]
Slide and cut-off valves, J. [illegible]
Clack valves (communicat[illegible] R. N. [illegible]), W. R. Lake. 3224.
Indicator of revolutions of driving-shaft (communication H. Lamotte), G. F. Redfern. 323[illegible].
Slide-valve gear (communication G. Klug), H. Simon. 3244.
V governor and escape valves, E. L. Beckwith and C. W. King. 3247.
Portable fog-horns or signals, S. Greenway. 3285.
Propellers, engines, and boilers, C. Jones. 3293.
Valves, G. Banford. 3308.
Propellors, J. Newall and G. W. Newall. 3311.
Steam steering gear, A. Higginson. 3320.
Designing and setting slide valves, J. King. 3349.
Ships' berths, J. L. Morice. 3353.
Improvements in ships or vessels, C. Tellier. 3354.
Floating syphon dock, A. Vogt. 3363.
Apparatus for adjusting piston packing rings, B. Williams and J. S. Matthews. 3375.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Parsons, Wm. ...	2 C	Sthmtn.
Kirk, Charles ...	2 C	N.Shlds.
Brown, F. S. ...	2 C	do.
Guinea, Richard	2 C	do.
Nelsen, Frederick	2 C	do.
Neville, Samuel...	2 C	do.
Dalton, Rbt. W.	2 C	do.
Besecke, Chas. W.	2 C	do.
Richards, N. H.	2 C	do.
Dingwall, James	2 C	Dundee.
Leask, Alex. R.	2 C	do.
Spence, Alex. ...	1 C	do.
Hay, Geo. L. ...	2 C	Lvrpool.
Barclay, Wm. B.	2 C	do.
Thompson, A. A.	2 C	do.
Forrester, Joseph	1 C	do.
Law, David ...	1 C	do.
Milward, J. C....	2 C	Bristol.
Thomas, Jno. ...	1 C	do.
Scott, George ...	2 C	Glasgow.
Muir, William ...	2 C	do.
Hewitt, A. J. ...	2 C	London.
Wing, James ...	1 C	do.
Walker, Wm. C.	1 C	do.
Shirra, James ...	1 C	do.
Bowie, Angus ...	1 C	do.
Kirk, Robert C.	1 C	do.
Reeves, Arthr. R.	1 C	Lvrpool.
Wilson, Alex. ...	2 C	N.Shlds.
Burnett, George	2 C	do.
Ewart, John B.	2 C	do.
Ralph, Thomas...	2 C	do.
Tate, Lotheran...	2 C	do.
Grant, Robert ...	2 C	do.
Morrison, G. V.	1 C	do.
Sibbald, George	2 C	Leith.
Stoker, John ...	2 C	do.
Greig, William ...	1 C	Dundee.
Melville, James...	2 C	London.
Munro, Donald...	2 C	Lvrpool.
Gray, Hugh P. ...	1 C	do.
Stevenson, Alex.	1 C	do.
M'Dougall, John	1 C	London.
Boyd, Andrew ...	2 C	Cork.
Mead, George E.	2 C	do.
Robertson, John	2 C	do.
M'Andrew, A....	1 C	Hull.
Hunt, Thos. M.	1 C	do.
Robertson, Jno.	1 C	Glasgow.
Kirkland, Jno....	1 C	do.
Newall, Geo. W.	2 C	London.
Grint, Fredk. F.	1 C	do.
Catterick, Thos.	2 C	Sndrlnd.
Leeson, Edwd. A.	2 C	do.
Hunter, Achbld.	2 C	do.
Bell, William ...	2 C	do.
Swinhoe, George	1 C	do.
Paterson, James	1 C	Lvrpool.
Truscott, Frank	2 C	Plymth.
Walker, Alex. ...	1 C	Hull.
M'Intyre, W. D.	2 C	London.
Oswald, James ...	2 C	do.
Millar, John ...	1 C	do.
Wilkinson, H. ...	1 C	do.
M'Kenzie, Robt.	2 C	Leith.
M'Laren, Robt...	2 C	do.
Wilson, John ...	1 C	do.
Williams, W. J.	2 C	London.
Cameron, John...	2 C	do.
Thurlow, Fredk.	2 C	do.
Cockell, Arthur	2 C	do.
Longman, C. ...	1 C	do.
Mackie, Andrew	2 C	Leith.

ROBERT JACKSON, Registrar-General.

General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

ADVERTISEMENTS must be sent in not later than the 23rd of each month to ensure insertion in the following number, addressed to W. G. Neal, 3, Amen Corner, Paternoster Row, London, E.C.

NOTICE TO THE TRADE.

THE "Marine Engineer" is now published by Grattan Marshall & Co., 3, Amen Corner, Paternoster Row, London, E.C. o whom all orders should be sent and P.O.O'S. &c., made payable. Yearly Subscriptions, 5s.

The Marine Engineer.

LONDON, OCTOBER 1, 1879.

EDITORIAL NOTES.

IT is strange what a fascination Arctic discovery has for maritime nations; first one, then another makes a bold push for the hitherto inaccessible North-west passage. "Cui bono?" The necessity or value of a North-west passage has long been considered of little weight, and it is now apparently only a morbid curiosity that still impels our brave seamen to waste their lives in the grim and cruel icefields of the Northern Seas. If there is any excuse for such a risk as must necessarily accompany navigation in such latitudes, it can only be found in commercial enterprise, which we believe is fairly brisk in furs and whale-fishing. We note that no news has yet been obtained of the Arctic expedition under Professor Nordenskjold. The Secretary of the United States Navy has received a communication from Lieutenant De Longs, commanding the Arctic steamer, *Jeannette*, and dated from Ounalaska Island, August 4th, 1879. He states that the report is that there has been very little ice this last winter in the Polar Seas. It may, therefore happen that Professor Nordenskjold may have successfully penetrated farther than most of his predecessors in their adventurous quest. The *Jeannette* met the Revenue cutter *Rush* at Ounalaska Island, which had been through Behring's Straits, and had called at St. Michael's, but no news had been there received of the whereabouts of the Professor. The *Jeannette* will go on to St. Michael's, and if nothing is there heard of the Professor's party they will proceed to St. Lawrence Bay, in Siberia, to look for tidings, and subsequently shall proceed in accordance with a plan before delineated.

THERE is some talk within the last few weeks of a revival of trade. No one will welcome this more heartily than ourselves, and it is surely time that a reaction should arise from the great depression in business of all kinds that we have passed through. It has always been so in the history of trade, alternate briskness and depression. The cause of this is not far to seek. An increase of trade follows immediately upon starved markets and an exhaustion of stocks. The moment a promise of better things appears all merchants will seek to fill up their stocks at the lowest figure of depression, and thereby unconsciously aid in rapidly increasing a demand which might have otherwise but been almost imperceptibly felt. Just so we expect it to be at the present moment. Once the rumour begins to gain credit that a rise in prices is imminent the merchant will at once greatly aid that rise by prompt purchases. Another great aid to future increased prosperity is that during the hard times we have passed through our merchants and ironmasters have learnt to produce their manufactured goods at prices that they would have deemed absurd and impossible a few years ago. Steel rails delivered in England at less than five pounds per ton contrasts wonderfully with the nine and ten pounds per ton easily obtained a few years back. And so with other manufactured goods. We have actually so cheapened production by cheaper materials, improved processes, and cheapened labour that we can at last sell our products in foreign and American markets in spite of their enormous protective duties. We must not, however, shut our eyes to the fact that we are losing many foreign markets never to return. There is no reason why protective duties should not be further increased in our foreign market to once more make it impossible for our manufacturers to make at a profit. Again, whatever further cheapness of production we may have attained by improved processes, may be also arrived at by our foreign competitors by their imitating us in such improvements. As regards ship and iron-clad building we fear that America, Russia, Italy, and Japan have for ever slipped out of our hands as purchasers of such goods from us. We fear that little by little, perhaps not in our generation, but too surely and certainly all outside markets will gradually slip away from us and become self-supplying where they have the raw products in equal quantity with ourselves, which is [illegible] as many countries besides our own [illegible] doubtless hereafter occupy an im- [illegible] as an iron and coal-supplying country, [illegible] other colonies and foreign countries [illegible] soon find their power of running alone, [illegible] in manufactured products from the [illegible] country. However, she is worth sticking to for a while, and the changes we forebode are but misty phantoms in the remote distance.

It appears that there is still some doubt in the minds of our navy constructors as to the value of the water-tight compartment system, on which our ironclads rely for floatation when pierced below the water line. We gather this from the fact that the *Agamemnon*, which has just been launched at Chatham, has a new modification in the shape of her water-tight compartments, being filled with cork instead of being empty. This provision ought certainly to aid materially in preventing the ingress of water in any volume into the water-tight compartments, even when pierced below the water line. There is not much else of novelty to note in the construction of the *Agamemnon*. It is surprising that not more has been done to improve the design or armament of our most reliable ironclads since five years ago, when the *Inflexible* was laid down. The *Inflexible* is not yet even ready for sea, and the *Agamemnon*, though now only launching, was laid down in 1876. She is but a duplicate of the *Inflexible*, with the difference that she is reduced in size or displacement, and therefore in cost, and is still to carry the same armour and armament, and thus represents less outlay for an equal power. The *Agamemnon* is reduced to 280 feet in length as compared with 325 feet for the *Inflexible*, a breadth of 66 ft. compared with 75 ft., and a displacement of 8,500 tons compared with 12,000 for the other vessel. Like the *Inflexible*, her armour is 18 inches thick on her citadel and turrets. Her turrets are placed *en échelon*; that is, not on the keel line, but one on each side, so as to be able to bring all her guns in succession firing ahead or astern. This is very important, as apparently in ramming matches it will be of essential importance to be able to fight end on to the opposing vessel or ram. The guns are, however, only two 38-ton guns in each turret, and however powerful these may have been considered in 1876, when the *Agamemnon* was laid down, we fear they are already out of date when the startling successes of the Krupp guns at Meppen are taken into consideration. However, though she may be nothing very new, we may congratulate ourselves on such a powerful addition as compared with the fleets of other nations to our ironclad monitors.

The science of naval warfare has received a new and somewhat amusing development. It is that of a new game for naval officers entitled a naval war game, and arranged by Captain Colomb to approximate as nearly as possible to the true conditions of warfare. There are certain well-known average conditions under which ironclads can manœuvre and fight at sea, and these are made use of to determine the different moves and scores of the game. For instance, an ironclad at full speed requires a definite time, from one to two minutes, to turn through an arc of ninety degrees, and the radius of that arc will be from two and a half to three times her length. Guns require a definite time between discharges, according to their calibre, and an ordinary port admits of an angle not exceeding sixty to ninety degrees for horizontal deviation. If now two vessels of definite armament, length, and construction be chosen, their relative possibility of movement, firing, and turning can be very accurately prescribed. The game is carried out on a drawing block with pencils, scales, and curves, graduated for intervals of time. The armaments, speed, and construction of the vessels are chosen by the opponents, and the first player is determined by lot. The whole of the successive waves will then be determined by equal intervals of time being allowed for the movements of each ship. They may ram or use artillery fire only or both, and the choice of when to fire and when to ram rests in the hands of the player, remembering that having once fired they cannot repeat until a stated interval has elapsed. The value of the shot in points will be governed by the distance and the inclination of the impinging shot. On the whole we are charmed with the diversity and yet absolute results of the game, and feel sure it will become a favourite with naval officers.

The *Polyphemus*, now being completed for commission at Chatham, promises to be a complete novelty amongst offensive ironclads. She is to be built entirely of steel, and her deck is to be covered over with three in. plating of a convex shape. This convex curvature is continued round her sides some distance below the water line, after which her sides converge towards her keel, or rather to where her keel should be in a V shape. Her midship section will thus appear the shape of a kite, the convex deck only rising 4 ft. 6 in. above her water line. She is 240 ft. between perpendiculars, the extreme breadth is 40 ft., and she will have a load draft of 20 ft. The engines are estimated to work up to 5,500 horse power, and to give her a speed of 17 knots. What a dangerous enemy she will prove is evident from her speed alone, as her principal means of offence are a ram or steel spur, and whitehead torpedoes. Her form of construction is evidently intended to enable her to escape notice, and even when observed to escape damage by the deflection of shot rather than by absolute resistance to such impact. There is much of interest and importance in this experiment, for such indeed it is, the vessel being constructed after the idea of Sir George Sartorius, a well-known veteran of the navy. We consider the *Polyphemus* as one of the first attempts in construction to foil the impact of heavy shot, by diversion rather than by the probably futile resistance of a heavy armour plating. Another important modification has been made in her construction to enable her to benefit to the full extent by the principle of subdivision into water-tight compartments, which is particularly carried out in her design, and on which she must very largely rely for safety. The modification is that an enormous mass of cast iron ballast is carried outside the vessel in a rectangular groove 1 ft. 8 in. wide, and 3 feet deep, situated where her keel should be. This mass of ballast amounts to 300 tons; her total displacement being 2,640 tons, and represents in weight a volume of rather more than ten thousand cubic feet. This ballast is so arranged that it can be released from the vessel at will, so that should one or more of her water-tight compartments be pierced, the loose ballast may be dropped from the part of the vessel corresponding to the flooded compartment. The position or power of floatation may thus be retained undisturbed, even after several compartments may have been pierced. She carries no masts, except for signal purposes, and her guns are a few light shell and Gatling guns on her upper deck.

FOUR experimental runs have just been made with the corvette Comus, which is built of steel and iron cased with wood, and has a horse power of 2,300, with a displacement of 2,383 tons. She gave a speed of nearly 13 knots, the engines indicating 2,440 horse power, and working at ninety-three and a half revolutions per minute. Three runs were made at two-thirds of the boiler power, with the following results:—Speed, 11·65 knots; power, 1,644; revolutions, 83·4. The engines were also worked at the lowest possible speed, or at about seventeen revolutions per minute. The trials took place under the personal direction of Vice-Admiral Sir W. H. Stewart, K.C.B., the Controller of the Navy, considerable interest attaching to this vessel, as she is one of the most modern and tentative type. She was built and engined by Messrs. Elder & Co., of Glasgow.

THE PHOSPHOR-BRONZE COMPANY, LIMITED.—Our attention has been called to a circular lately issued by Worshipful Company of Turners, offering prizes for the successful competitors in hand-turning of wood, stone, iron, steel, brass, and gun metal. The Company, it appears, have sanctioned the admission of specimens of phosphor-bronze as gun metal in the competition for the prizes and freedom referred to in the circular. The Phosphor-Bronze Company request us to say that they will be happy to render assistance to the competitors by purchasing at a reasonable price the specimens of phosphor-bronze submitted to the judges, particularly such as have gained their commendation or any of the prizes. Phosphor-bronze can be supplied by the Company either in ingots or castings to pattern, and specimens may be seen at the offices, 139, Cannon Street, London, E.C.

THE "AGAMEMNON."

ON Wednesday last the central citadel ironclad ship Agamemnon was successfully launched from Her Majesty's dockyard at Chatham, in the presence of many thousands of spectators. This is the second ironclad of the type known as "central citadel ships" launched for our navy, the first being the Inflexible, about which controversy raged so fiercely a year or two ago. The Agamemnon is a sister vessel to the Ajax, building at Pembroke. They are in the essential features of their design similar to the Inflexible, but they are smaller, less powerful, and less costly than the latter vessel.

The length of the Agamemnon is 280 ft., as compared with the Inflexible, 320 ft. The Agamemnon has 66 ft. beam, the Inflexible 75 ft., and the former has a load draught of water of 23 ft. forward and 24 ft. aft, giving a mean draught of 23 ft. 6 in. against the Inflexible 24 ft. 6 in. The difference in size will be seen in a still more marked degree by comparing the displacements, the Agamemnon having an estimated load displacement of 8,500 tons, against the Inflexible's 11,500 tons. Like the Inflexible she consists of a central armour-plated citadel extending about 9 ft. 6 in. above the water for about one-third the length of the ship, the remaining two-thirds being unprotected except by a 3 in. armour deck situated about 6 ft. below the water. The armour on the citadel extends down 6 ft. below the water, and varies in thickness from 18 in. to 11 in., the corresponding thicknesses for the Inflexible being 24 in. and 16 in. This armoured citadel encloses the magazines, engines, boilers, and the turning and loading gear for the two turrets which rise above. The turrets are plated with 16 in. armour, and each is to carry a pair of 38-ton muzzle-loading guns of the Woolwich pattern. The turrets are placed some distance out from the middle line of the ship, one on each side, so that the four turret guns can be fought together, either direct ahead or direct astern, and they can also be all four fought on either broadside. It is doubtless an advantage to have the turrets placed *en échelon*, so as to get a powerful bow fire, but it must not be forgotten that we pay for it by sacrificing half the fighting power on one bow, and on the opposite quarter; and, what is also of much importance, owing to the fighting power of the ship being unsymmetrical, an enemy will probably be able to count with some certainty upon her movements in action, for he will know the direction in which she will always wish to turn.

Before and abaft the citadel the vessel is built up of light material unarmoured, and above the armoured deck this space in the region of the water line is subdivided into water-tight compartments, which are to be filled in with cork to prevent the vessel sinking in the event of the ends being struck below water. The usefulness of this was one of the bones of contention in the Inflexible controversy. Mr. E. J. Reed, together with ourselves and others, contended that the cork stuffing could not be depended upon, and that the armoured citadel should be sufficiently large to insure the safety of the ship against capsizing if the unarmoured ends in the region of the water line were riddled and the cork blown out. It was at first contended on behalf of the Admiralty Constructors that this condition was fulfilled in the vessels in question, and afterwards the defence was shifted, and it was argued that the condition was an unnecessary one. The defective stability which we condemned in the design of the Inflexible exists to as great an extent, probably greater, in both the Ajax and Agamemnon, and in this respect we condemn them as strongly as we did the Inflexible, for we are convinced they will prove treacherous in a naval action.

The engines are intended to indicate 6,000 horse power, and the speed of the vessel is estimated at 13 knots. She is fitted with twin screws, and is designed to carry 700 tons of coal, which is equivalent to from five to six days' steaming at full speed. Above the citadel deck there is a flying deck superstructure for working the ship. The loading and working of the guns will be performed by means of hydraulic machinery. The vessel has a ram bow, like all recently-built ironclads, and will be fitted with appliances for ejecting Whitehead's fish torpedoes from the armoured sides of the citadel. She will be of the mastless monitor type, and will consequently have to depend entirely upon her steam-power like the Inflexible, Dreadnought, Thunderer, and Devastation.

In offensive and defensive powers she is far below the Inflexible, having four 35-ton guns against the latter's four 80-ton guns, and, as we have shown, having 18-in. armour against 24-in. Compared with the Devastation and Thunderer she appears in a better light, the armour being thicker, 18-in. against 14-in., and the armament being somewhat heavier. Against this, however, the Devastation type of ship has complete armour protection all fore and aft, while the Agamemnon is liable to have her speed destroyed, her trim upset, and stability compromised by common shells, without being once pierced through her armour.

The vessel is built on the longitudinal and bracket plate system with a double bottom, as is customary in heavy ships of war, and she is well divided into water-tight compartments. Especially is this so in the engine and boiler space, where a marked improvement has been made in this respect of late years in our navy. She will carry a crew of about 350 men, and will be provisioned for about six weeks.

The weight of armour and backing of this vessel approaches 3,000 tons, and the weight of the guns and ammunition slightly exceeds 400 tons.

Some further particulars relating to the arrangement of armour and backing may not be without interest. Like the Inflexible the armour is in two thicknesses with wood backing between, in this respect differing from the Devastation and all former ships, where a great point was made of keeping the armour in one thickness only, it having been found up to certain thicknesses that the resistance to penetration varied nearly as the square of the thickness, and hence one thick plate was considerably stronger than two plates of the same total thickness. The outer thickness of armour on the citadel will probably be of steel. Behind this comes 11 in. of backing fitted between vertical iron girders 11 in. deep. Behind this again comes the second thickness of armour, and behind this about 7 in. of teak backing fitted between horizontal girders of an equal depth. These are attached to the shell plating of the ship, which is in two thicknesses, each ½ in., through which also the whole of the armour and backing is bolted. Inside of this plating come the deep frames of the ship. The total thickness of wood-backing on the citadel is 18 in., the same as that of the thickest armour, but like the armour it varies in thickness at different parts. The 3-in. armoured deck is also made up of two thicknesses, one being 2 in. the other 1 in. thick.

It has been pointed out by some of our contemporaries that the Agamemnon was designed three years ago, that it has taken this time to complete her sufficiently for launching, and that the Inflexible, which was designed six years ago, is not yet completed. It is a question worthy of serious consideration whether this time could not be much shortened by greater simplicity of construction without adding to the weight or at all diminishing the strength of the ships.

In the three new ships, the Colossus, Conqueror, and Majestic just commenced, steel will be largely used for the plating, and will be so far an advance upon the Agamemnon, but when it is said that these ships will, "in all probability, be out of date before they are well finished," the question arises whether it would not be wiser to order fewer ships from one design and to push what are ordered more rapidly towards completion.

In glancing back over the history of our ironclad fleet no one can fail to observe that a great change, for good or evil, has taken place in the very principles of their design during the last few years. Noticing only the broader features, the first important change made from the early long ships of the Minotaur type, completely protected from stem to stern, was the introduction of the central battery and belt of armour at the water line. This is seen in the Bellerophon and subsequent vessels as well as in some small wooden, converted ships. This change enabled the armour to be thickened, and simultaneously the length of our first-class ironclads was reduced from 400 ft. long to about 300 ft. This became the type of the masted ironclad cruiser, a vessel capable of keeping the sea for months together. The next great type introduced, apart from vessels for coast or harbour defence or special purposes, was the heavy, mastless monitor of the Devastation type, which made up in some degree for the absence of masts and sails by an unusually large supply of coal. By this great change we were enabled to rise at a bound from 8 in. or 9 in. armour protection to 14 in. armour, and from 18 ton to 35 ton guns. Here, also, it will be noticed we return to complete protection.

The next great change was to the citadel type of ship, which, like the Bellerophon and the Devastation types, was undoubtedly projected by Mr. E. J. Reed before he left the Admiralty, although not worked out by him in detail. Foreseeing that the time was approaching when side armour would have to be still further thickened to withstand the growing power of artillery, he proposed to confine it to a central citadel at the middle and broadest part of the ship, which would protect the vital parts and be sufficiently large to insure the buoyancy and stability of the ship in action, while side armour at the ends of the ship was discarded, and a thick armour deck substituted for it 6 ft. below water.

From the nature of this type of ship much greater beam than had hitherto been adopted became an obvious necessity, and accompanying the change, when it took practical form in the Inflexible six years ago, a great stride in the direction of greater beam took place. This type of ship is now embodied in the Inflexible, the Agamemnon, the Ajax, and the more recent heavy armour-clad ships designed for our navy; but with one important exception, which led to the Inflexible controversy, viz., the condition mentioned above, that the central armoured citadel should be sufficiently large to insure the ship against capsizing, whatever happened to the unarmoured ends, is not fulfilled in these vessels. It could easily be fulfilled in vessels of this type, with little if any appreciable sacrifice in other directions, but it is not done. Up to the time of the Inflexible controversy this fact was not known even to the Board of Admiralty, and was stoutly denied. It has since been persevered in with their sanction, although even the Inflexible Committee recommended that this precaution should be adopted in future designs.

We have then this further change to record, viz., that armour protection for the vessel's stability has also now been abandoned, even where for this purpose but a slight enlargement would be required in the citadel that surrounds the engines, boilers, ammunition, and turret machinery. The last step we look upon as a deplorable one, but it has been accepted by the authorities in spite of argument and protest, and we must wait the result, unless in the meantime the questions at issue are put to the test of practical artillery experiments.

The visitors to the launch of the Agamemnon would have had an opportunity of observing a ship building alongside which is certainly the most remarkable vessel yet designed or built for our navy. We refer to the ironclad torpedo ram Polyphemus, once we believe known as the Sartorius Ram, from the general features of the design having been suggested by the late Admiral Sir George Sartorius. In addition to this the ironclad Conqueror has just been commenced, and the Constance, an unarmoured cruiser, some distance advanced.—*Engineering*.

THE "ORIENT'S" TRIAL TRIP.

THE finest passenger ship that has ever ascended the Thames was berthed on Saturday in the outer basin of the South West India Dock. The only vessels with which the Orient can be compared (the Great Eastern, which turned out to roll too much for passengers' use, may be left out of account) are two or three recently built for the Atlantic service. These steam in and out of the Mersey; but how little the London docks are accustomed to vessels so long and heavy as the Orient was shown on Saturday by the fact that three Thames tugs pulling at her stern all together were required to keep the great steam ship straight against the flowing tide, and so enable her to squeeze, so to speak, through the entrance of the docks. The increasing size of steamships will make more powerful tugs and ampler dock accommodation necessary on the London river. It is twenty years since the Great Eastern started on her trial trip from London to Weymouth. The change of centre in the shipbuilding trade is marked by the fact that the merchant steamship which has, next to the Great Eastern, attracted public attention, started from the Clyde and not from London waters. The shipbuilding yards of Glasgow and Greenock have out of all proportion contributed to the great increase in powerful steamers, which'dates from the opening of the Suez Canal in 1869. The Orient is the 224th which her builders have launched from the stocks, and the 124th built since 1870. At the moment there is some cessation in the activity of the Clyde, but great passenger steamships still continue to be built.

That memorable voyage of the Great Eastern was marked by incidents which have fortunately not attended the trial trip of her successor. The outer jacket of the second funnel of the Great Eastern blew up, scalding twenty-three men, and the steering gear gave way before the run down the Channel was finished. The trip of the Orient has been distinguished by the perfect working of the ship herself, and of all the smaller machines the sum of which she is. In twenty years a good deal has been done to add to the safety and steadiness of steamships, and the speciality of the Orient (apart from her unusual size) is that the newest and best appliances have been sought for in building her, with the object of attaining the *maximum* speed and comfort to be reached in ocean navigation. You have already inserted an account of the Orient, from which it appears that she is the largest ship built at Glasgow and the largest built on the Clyde, if the Inman steamship City of Berlin be excepted. The Britannic and the Germanic of the White Star Line, and the Arizona of the Guion Line, are other great vessels with which she may be compared. I am informed now by the superintendent of the Orient Line that her displacement weight, when she is loaded, exceeds that of the City of Berlin by 700 tons, and that she may thus, if weight of load calculated on the principle of displacement of water be taken as the basis of calculation, be placed second to the Great Eastern in size of merchant ships. The displacement weight of the Orient is 9,500 tons; her registered tonnage is 5,400 tons; her contract price was £130,000, and the additional fittings which she requires will raise her cost to £150,000. Her length is 445 ft. 6 in.; her beam, 46·35 ft., her depth to main deck 27·1 ft., toupper deck 35·1 ft. She had on board on starting from the Clyde 2,600 tons of coal, with 400 tons of pig-iron as ballast. She burnt about 160 tons on the trip. She drew about 23 ft. When she takes her place on the service of the direct Orient line to Australia, for which she has been built, the Orient will be prepared to carry in addition to 3,000 tons of Welsh coal (more than sufficient to take her to Australia) 3,600 tons of measurement cargo, which might weigh 1,000 tons or so more than the nominal amount. She would also carry 120 first-class passengers, 130 second-class, and 300 third-class or steerage passengers. The latter would be conveyed and provided with fresh meat, bread, and other provisions all the way, for £15. By a sacrifice of cargo space she would carry 285 more third-class passengers. A different arrangement of space would enable 1,500 troops and 400 horses to be carried in addition to the other passengers, and, if entirely devoted to troops, the ship would convey 3,000 men and 400 horses at once with the proper stores. She is expected to make the voyage to Australia in thirty-six days.

There was on the trial trip a party of 120 on board, all gentlemen, and the trip was thus distinguished from Wednesday's experimental cruise to Wemyss Bay, in which ladies took part, and in the course of which a Princess of Thule arrested the course of the great ship at full speed by one movement of a lever. Among those on board on the longer trip were Mr. J. Holms, the member for Hackney, and colleague of Professor Fawcett; Captain Gorringe, the officer of the American Navy, who is going to Alexandria to bring back the obelisk for New York; Mr. George H. Chambers, the Conservative candidate for Bristol at a recent election, and chairman of the London and St. Katharine's Docks, and of other great companies; Mr. Thomas H. Ismay, of the White Star Line; the Hon. A. M'Alister, Agent-General for Queensland; Mr. S. Yardley, Secretary in England for New South Wales; Mr. J. Cashel Hoey, secretary to the Agent-General for Victoria; Mr. C. R. Tatham, chairman of the Shipowners' Society; Mr. James Dunn, of the Admiralty, who has had much to do in surveying merchant and mail steamers, and advising those precautions in their construction which have enabled the Admiralty to form a list of swift and powerful cruisers available to our hand at a moment's notice in a time of war; Mr. W. H. Bisset, one of the most trusted officials of the Board of Trade; Mr. W. J. Page, assistant secretary to the Post-Office; Colonel J. L. Du Plat Taylor, secretary of the East and West India Dock Company; Mr. L. R. Baily, chairman of the Pacific Steam Navigation Company; Mr. P. Rankin, Mr. Nicholson, and Mr. James Robinson, three of the directors; and Mr. A. M. Saunderson, the able manager and secretary; Mr. James Park, of Lloyd's Committee; Mr. B. Waymouth, the secretary to Lloyd's; Mr. W. Parker, principal engineer surveyor to Lloyd's; Mr. James Purdie, Mr. J. Williamson, and Mr. H. Cornish, Lloyd's surveyors; Mr. J. H. Matthews, of Grindlay & Co.; Mr. N. Garrett, of Aldeburgh; the Rev. C. P. Grant, vicar of Portsmouth; Mr. Slater, of the Midland Railway; Mr. Stevenson; Mr. Baden-Powell; Captain Bain; Captain Elmslie, of the Sobraon; Mr. James Pearce, head of the builders' firm (Messrs. John Elder & Co.); Mr. J. M. Macdonald (Matheson & Co.); Mr. G. Hopcraft; Mr. T. Ormiston; Mr. J. Willianson, chairman of the Liverpool Shipowners' Association; Mr. F. Green, and Mr. Charles Green, of F. Green and Co.; and Mr. James Anderson, Mr. J. G. Anderson, and Mr. W. Anderson, of Anderson, Anderson, & Co., joint managers of the Orient Company.

Of the behaviour of the Orient during her trial trip there is little to say. She is as fortunate in that as the nation which has no history. The patent log which hangs from her stern and records the speed of the ship upon a dial, marked, on the average, 14½ to 15 miles per hour through the water; on Thursday morning, when she passed within sight of Dublin Bay, and met the Holyhead packet entering, she was making 17 knots. As 15 knots through the water represented during a portion of the day 17 over the ground—for she had the tide with her, and a knot is about a sixth more than a mile—the total rate achieved during a portion of the voyage may be put down as 20 miles an hour. If all the 754 sea miles between Greenock and London had been done at the same speed, and if she had travelled by the shortest course she would have been in the South-west India Docks before Saturday; but the average was, of course, lower. No rate approaching her speed in the ocean could safely be steamed in the Thames, and it was not desired to enter the river by night. The steamer, therefore, cast anchor at the mouth of the Thames, in Margate Roads, and waited for the daylight before ascending the river.

We started from Greenock (which the party reached by special train from Glasgow) at half-past 5 on Wednesday evening, with a salute and "God Save the Queen" from Mr. John Burns's yacht, and the honour of lowered ensigns from Wemyss Castle and the yachts met in the Clyde. The wind was west-north-west. We steamed past Bute and the two Cumbræs and Arran, with the serrated edges of Goat Fell towering above us in the dusk. At night we saw the glow of the Ardrossan Iron Works in the sky like the radiance of the rising moon, and the rays of the young moon herself coming out from behind Ailsa Craig. We lost the Scottish coast at the Mull of Galloway, and picked up the Irish coast at the lights outside Belfast. Through the night we steamed south at the rate of 13½ miles an hour, the wind being now against us, west-south-west, a fresh breeze, the sky clouded, and the weather thick at times. We passed west of the Isle of Man, sighted the red and white light on the Chicken Rock, and several lights down the coast of Ireland. The Tuskar Rock at the south-east of Ireland was made at 11.40 a.m. on Thursday. In the afternoon we were in the midst of the Atlantic rollers, and it was blowing a gale from west-south-west. The ship never rolled enough to spill a drop of water from a wine-glass filled to the brim placed on the table of the saloon; but there was, it must be confessed, sufficient motion (unless the mere aspect of the white horses sufficed) to make ten or fewer of the 120 passengers ill. The sea rose towards night, and the spirits of most of the party rose with it, in the hope of weather which would still more amply test the sea-going capacity of the vessel. Owing to stowage or to taking the coal from one side, the wind being on the starboard bow, she had a slight list to port. It was too wet and cloudy all day to see the sun, and no observation had been taken. We steamed ten hours at a speed of over 13 knots an hour, and it was not till 9 or 10 o'clock that we saw the lights which proved that the courses had been rightly laid. It was

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The weight of [illegible] proaches 3,000 t[illegible] ammunition slig[illegible]

Some further [illegible] armour and he[illegible] the Inflexible [illegible] backing bet[illegible] tation and [illegible] of keepin[illegible] found [illegible] tratio[illegible] h[illegible]

[illegible] ahead [illegible] miles [illegible] the [illegible] sailing [illegible] down [illegible] to be [illegible] we were [illegible] Longships [illegible] one of the [illegible] the Lizard, [illegible] was a beautiful [illegible] radiance. We [illegible] 2½ miles. The [illegible] black on the deck; [illegible] unnatural brightness [illegible] add to the terrors of [illegible] hands of our watch- [illegible] league away. Now a [illegible] hitherto we had travelled [illegible] to the west; a due south- [illegible] changed shortly afterwards to [illegible] a change was apparent in [illegible] Channel brought a welcome [illegible] Atlantic. The night became fine [illegible] was passed at 2.15 a.m., distant 7½ [illegible] from the south (the quarter from [illegible] we got clear of Galloway), with hazy [illegible] 14 and 15 knots. When the sun [illegible] the pleasant south country, green [illegible] and we signalled our name at 10.23 [illegible] St. Catherine's, the southernmost point of the [illegible] we had run 338 miles by the log, 334 by [illegible] o'clock we had begun a trial of the engines, [illegible] The list to port slightly impeded the [illegible] crew put on board by the builders were not [illegible] afford so many reliefs to the stoking as [illegible] but when the stokers turned up with [illegible] asking for beer, and the officers and owners [illegible] the speed, it was found we had made an [illegible] in the first four hours and 16·7 in the latter [illegible] trial was made—that of some rocket signals [illegible] rocket" rockets. They make two reports, one [illegible] discharged, the next when the rocket bursts in the air. [illegible] the more important, since the sound travels best [illegible] point reached. Great certainty and distinctness in [illegible] have now been achieved. The 24 hours commencing [illegible] Friday at noon began with fine and cloudy weather and a [illegible] breeze. In spite of clouds it was easy to see Brighton, Eastbourne, and the other watering-places which cluster round the [illegible] promontory of Beachy Head. About four miles before we reached the low point of Dungeness we passed on our starboard side, so near that a biscuit could have been thrown to them, two masts of a ship which had been wrecked. They were two-and-a-half feet or so above the water. There was no buoy to mark the wreck, and it offered a danger to navigation which is worthy of immediate attention. We signalled again to Dungeness and Dover, made the Goodwins at 6.24 and 7.25 (the weather being cloudy with rain), stopped the engines and anchored four miles from the lights of Margate town, just inside Margate Sand, and thus in the estuary of the Thames. The voyage had been accomplished from the Clyde to the Thames in 49 hours, 55 minutes. The distance run was 712 nautical miles. These figures divided by 50 (taking 50 roughly as the number of hours) give an average speed of 14¼ knots, or 16½ land miles an hour. According to another calculation the average [illegible] The night was dark and cloudy with rain, and it was [illegible] ance of the rules of the road, but by a praise- [illegible] a ship) absolutely necessary precaution, a [illegible] was exhibited at the stern as well as at the bow while [illegible] r. The Scotch pilot, Captain M'Kelvie, with 60 [illegible] had charge of the ship on the part of the builders, [illegible] crew coming on board in London, where she was [illegible] to the owners in the dock by the symbolical process of [illegible] over her registry. She starts for Australia on the 3rd of November. Most of the officers, including Captain Hewison, were [illegible] on board, with Captain Storey, an old Queen's pilot, who [illegible] charge of all the ships of the line, and took this one in hand at Dungeness. He is the second pilot in seniority of those on the Trinity-house books, and is licensed from London-bridge to St. Petersburgh. In 1854 he was in the Baltic with Sir Charles Napier, and if it were not for his age, which exceeds 60—though he is as hale as the famous pilot of whom "a green old age" was first written by Virgil—would be liable to be called on again in time of war. The red and white flag was hung at the stern when Dungeness was reached, to show we had our own pilot. The voyage being over the evening was given to festivity. The dinner-table had now no vacant places. Mr. James Anderson was in the chair, and the Hon. A. M'Alister, the Agent-General for Queensland, in giving "The Health of the Managers," said this was the most magnificent steamer afloat. Mr. J. G. Anderson replied, and Mr. Pearce, head of John Elder & Co., in his speech, said he had let his staff and men understand that the ship had to be built by them for the sake of their standing as a firm, since it was to be a leading steamship in the world. Mr. J. Holms, M.P., in his address, referred to the political and economical importance of directing emigration to our own colonies as this line did. Steam communication with Australia was, he observed, in its infancy. Mr. James Anderson, in acknowledging the toast of his own health, told an amusing story of a ship the designs for which he draughted in his youth. She was a sailing vessel of 50 tons, and when they launched her the foreman said, "Well, I don't think there will be much improvement on that."

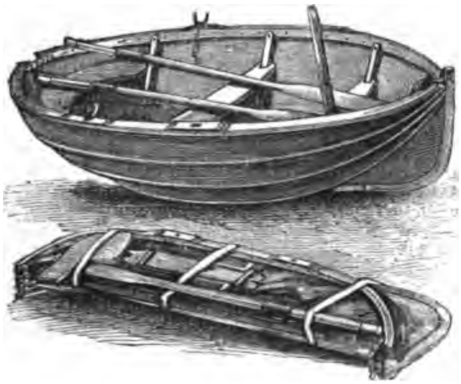
On Saturday morning we weighed at 5·20, took our river pilot off Gravesend at 9, and passed on the way up the Red Jacket, a once famous Australian clipper of the gold days, which had accomplished the passage in fifty-six days by sails alone. Sailing ships with auxiliary steam have since come into use for Australia, but the Orient is not only by far the largest in the trade, but also the first full-powered steamship built for it. The Orient could sail at five knots an hour without steaming. Had the temporary crew with which she came to the Clyde been larger in number, we should probably have tried her sails as auxiliary to steam, and even increased our speed. The heavy mass of the ship was pioneered with the greatest ease and accuracy through the devious and crowded Thames. The docks and landing-places were lined with spectators. The crews of the training-ships and of the vessels moored or docking rushed to the side to see the great ship pass. The three tugs, Lord Warden, Middlesex, and Vigilant, had accompanied her up the river. As her nose was put to the dock gates the tide on which she had come up took her gigantic bulk across the stream, which it nearly bridged. There was a grinding and crashing of fenders and piles; the tugs hurried back to the stern and pulled the steel hawsers taut to counteract the leverage of 445 ft. of rigid length acted on by a strong tide. She was slowly warped by hydraulic capstans into dock, and the cruise was over.

The days had been given to inspection of the ship by detachments of visitors. The walk round takes two hours. It will be desirable to add a few particulars to the account which has already appeared. One of the causes of the steadiness of the ship, besides her boat-like lines, is to be found in her having three cylinders instead of the common number of two; one is high pressure with 60 in. diameter, the others low pressure, 85 in. diameter. The crank-shaft is built in separate pieces, shrunk together and keyed, the diameter of the shaft being 20 in. and that of the crank-pins, which are of steel, 21 in. The propeller is four-bladed, the boss being of annealed cast-iron and the blade of cast-steel, specially made for the purpose by Messrs. Vickers, of Sheffield. The blades are bent backwards to diminish vibration. The diameter of the screw is 22 ft. and the pitch 30 ft. The condenser contains nearly 12,000 square feet of cooling surface, and the water for condensation is circulated by means of two independent combined steam centrifugal pumps, made by Messrs. Gwynne & Co., Essex Street Works, London. The condensing surface and the capacity of the centrifugal pumps are made larger than they otherwise would be, because the temperature of the water on part of the voyage home—namely in the Red Sea—is so high that an unusually large quantity of it is required to cool and so condense the steam. The reversing engine is a special feature. Moving a lever not only stops the engines when at full speed, but immediately turns them full speed astern, and this motion has been so simplified that Lady Gertrude Boyle, on visiting the engine-room during the experimental cruise on the Clyde easily stopped and reversed the engines when going at their *maximum* speed—that is to say, a young lady with one movement of her arm did what was tantamount to reining in 5,600 horses. The boilers are four in number, 15 ft. 6 in. diameter, by 17 ft. 6 in. long. They contain 24 furnaces, each 4 ft. diameter by 6 ft. long, and the working pressure is 75 lb. on the square inch. The furnaces are constructed with special arrangements for the economical consumption of Australian coal on the passage home. From the results obtained it has been definitely proved that the consumption of coal will be economical at the speed at which it is intended she should run—namely, 14 knots an hour. She will probably burn 70 tons a day. The engines worked very coolly without priming on the trip. The special arrangements of the machinery are due to the ingenuity of Mr. A. D. Bryce, the able superintendent of this department for John Elder and Co. Including the five steam winches, the strong and delicate steam steering gear, the donkeys, the pumping engines, the Gwynne's circulating pump engines, &c., she has 16 engines in her. With her 840 passengers, and a crew of 150 on board, the ship, which has been compared to a house, would really be like a town, and the arrangements for supplying her with water, for example, are similar to those which would be made for a town. The large tanks fitted below the orlop deck in the after-part of the ship hold about 80 tons. These are of course filled when the ship leaves the docks, but to keep up the supply required for daily use there are two large condensers, which will condense, if required, 200 gallons per minute. The water when leaving the condenser enters a cooling tank fitted with a large spreader or aërator. From this tank it runs direct to the main tank, from which it is again pumped by a small steam-pump in the engine-room to a very large tank fitted on the promenade deck, whence it runs to every compartment into smaller tanks. Ice-rooms are fitted on the lower deck for carrying 60 tons of ice. The true protection against fire is that the sea can be admitted bodily into any two of the 13 water-tight compartments without sinking the ship. The protection against drowning is supplied by four lifeboats, carrying 80 each, two cutters to convey 90 each, a gig and a mail-boat calculated to sustain 45 each, and 24 life-buoys, a large steam launch, and two life-rafts, each capable of saving from 40 to 60 people. In every berth in every class is a life-jacket which, rolled up, may be used as a bolster. Cattle enough to stock a farm are carried to provide fresh meat and milk on the voyage. A smaller ship of the line takes out six bullocks, 100 sheep, 300 dozen of poultry, and embarks 12 bullocks more at the Cape. Mosses and Mitchell's automatic ventilators, used in the British and American navies, are fitted to all the lower decks of the ship. When scuppers are closed in stormy weather, these ventilators increase in activity and expel the foul air through gigantic cowls. A special ventilator of Mr. Shepherd's (marine superintendent to the Orient Company), only applied to the Donald Currie Line and to this steamer, keeps the first and second class cabins sweet. A great feature of the first class accommodation is the splendid saloon forward, free from the engine room, free from berths, running through from side to side, fitted with electro-plated brass furniture, carpeted with a pattern by William Morris, and opening into the music saloon above, where, amid ferns and dracænas growing as plentifully as in the sunbeam, a piano and an organ are to be placed. Here are elaborate wood carvings and ornamentation again in patterns of the English Renaissance of the nineteenth century. The third class accommodation supplies separate cabins with two berths for £18 per berth, and berths approached by separate passages for £15. The crew's forecastle is very spacious and comfortable. The vessel has been wholly built since the ideas for a merchant contingent to the English navy, in which Mr. W. H Smith has so much interested himself, took practical shape, and has been constructed throughout with a view to the requirements of cruising. Thus she is fitted not only with fore and aft vertical iron bulkheads, at a distance of 6ft. and 12 ft from the sides of the ship, but also with horizontal bulkheads, at about 5ft. below the water-line. There is also an arrangement of fire bulkheads between the main and upper decks which would cut off a part of the ship which might by accident be on fire. These bulkheads also support the upper deck, and enable heavy guns to be carried on it. There are large square ports in the side of the ship to allow of heavy guns being carried and used on the main deck. From smaller ports in the side, in the neighbourhood of the water-line, torpedoes could be fired. The boats can be stowed and secured inboard, and the davits used for carrying torpedo boats, the great length of the ship being such that a dozen of these modern war vessels could be carried along her sides. The arrangements detailed give the ship great strength for her ordinary service, and while it is to be hoped that they will only be called into use for that purpose, there is no doubt that in case of war the Orient would be a valuable auxiliary to the regular navy.—*The Times.*

NEW TURRET SHIP.—The building of the last and most improved turret ship for the English Navy has now fairly commenced at Portsmouth. She is to be named the Colossus, and will be a twin-screw turret ship, with a central armoured citadel, her principal dimensions being:—Total length between the perpendiculars, 325 ft., and extreme breadth 68 ft., with a displacement of 9,150 tons. Her vertical steel plates are to be of 20 lb. to the square foot, with a depth of 31 in., except outside the double bottom, where it is to be reduced by the depth of the inner angle steels of the transverse frames, and tapering towards the extremities of the ship. The plates are to be at least 12 ft. in length, and are to extend continuously from stem to stern. The flat keel plates are to be worked in two thicknesses, the upper 25·5 lb. per square foot, tapering to 23 lb. forward and aft; and the lower 34 lb., tapering to 23 lb. The angle steels connecting the vertical keel plates and the flat keel plates are to be 4 in. by 4 in. and of 18 lb. per square foot, those on the upper edge of the vertical keel plate to be 3 in. by 3 in. to 7·8 lb. per square foot. The angle steels are to be continuous and worked in the greatest lengths procurable, while the bolts of the vertical keel plates are to be secured by double bolt straps, to be in length sixteen and a half times the diameter of the rivets. The bolt straps are to be worked on each side of the keel, angle steels extending to the edge of the plates, and to be of the same thickness as the plates to which they belong. The bolts of the angle steels are to be secured by bolt straps of the same thickness as the angle steels, and of such a length as to take not less than two rivets in each flange on each side of the bolt. The edges of the inner of the flat keel plates are to be single rivetted to the outer plating, and the vertical keel will be carefully fitted and caulked throughout the length of the double bottom, so that the latter may be divided into water-tight compartments. The stern post and afterpart of the keel are to be in one forging of best iron, and at fore and after ends of the ship the flat keel plates are to be scarphed with the lower parts of the stem and stern post. The frame of the rudder is to be also forged of the best iron, and the sides are to be of steel plating 17 lb. to the square foot. Means are to be adopted for steering below the armoured deck. The stem is to be forged of the best iron, the lower end to be scarphed on to the vertical and flat keel plates; the ram to be formed of two armour plates arranged so as to be removed, being completed and made water-tight without it. The stem and ram will be supported by an armour-plate 3 in. thick, bent over the stem and rabbetted into it. The plate is to be 12 ft. long, running as high as may be considered necessary. The longitudinal frames are to be continuous, and extended as far forward and aft as required; to be formed of plates from 16 ft. to 20 ft. in length and angle steels. No. 1 longitudinal and shelf plate are to be parallel throughout the length of the citadel in breadth; the remainder of the longitudinals are to be parallel throughout the length of the citadel, and to taper from thence to the extremities of the double bottom, but not to a greater extent than 4 in. The longitudinals are to be reduced in depth before and abaft the double bottom, and to taper towards the extremities. The transverse frames in the double bottoms are to consist of solid frames about 20 ft. apart, and intermediate frames 4 ft. apart, are to be formed of bracket plates and angles, except above the second longitudinal, and also beneath the engine bearers, where solid frames, lightened with holes, are to be used. The plates for these frames are to be 13 lb. to the square foot, and are to be cut short of the inner and outer bottoms and longitudinals. Before and abaft the double bottom the transverse frames are to be 4 ft. apart. The vertical framing behind the armour is to be 2 ft. apart, and of steel. The frames outside the citadel are to be formed of angle steel and placed 4 ft. apart. The frames to superstructure are to be formed of angle steel, 7 ft. 3 in., of 11·8 lb. per foot, and placed 4 ft. apart. The frame is to be specially strengthened near the blast of the guns. The boiler rooms will be divided at the middle line by a water-tight bulkhead, running from the top of the inner bottom to above the load water line. Throughout the engine-room there will be a longitudinal bulkhead on the starboard side at 4 ft. from the middle line. Before and abaft the citadel, between the lower and middle decks, divisional bulkheads are to be worked. The deck beams are to be of steel, and the glacis plate is to be worked round each turret on the deck over the citadel. The deck flats are to be of Dantzic crown deals, and steel is to be used in the magazines, shell, and like rooms. In several respects it will be seen that the Colossus will be on a diminished scale.

THE "BERTHON" COLLAPSIBLE BOAT.

It is astonishing to consider in these days of pronounced humanitarian principles what comparatively little attention is paid or enforced as to proper boat-saving accommodation being provided on emigrant and passenger vessels. There are, as we all know, certain regulations laid down in the Merchant Shipping Act which must be complied with, to evade the penalties of the law under accident and loss of life, but at the same time these provisions are entirely unfitted to ensure proper boat or life-saving accommodation to vessels which may be carrying a full freight of human beings. As for instance in the lamentable cases of the *Cospatrick*, burnt at sea, with a frightful loss of life out of 500 passengers, and also the *Northfleet*, run down off Dungeness, with an equally heavy loss of life out of 490 passengers, it was stated in the Board of Trade reports on both these accidents that the vessels were provided with all the boat accommodation required by law. When this accommodation was calculated, it was found that it provided for only 147 persons in the one case and 145 in the other.



In fact, it has been hitherto pretty generally acknowledged that no emigrant vessel or passenger and troopship is able to carry sufficient boats to accommodate a full freight of human beings in case of a sudden founder at sea. Mr. Berthon's invention of a collapsible boat has now brought the space required to store a life-boat into such remarkably small dimensions that there cannot henceforth be any reasonable excuse for neglecting to carry boat accommodation sufficient to float all the passengers and crew.

Mr. Berthon's collapsible boat is built on the principle of longitudinal frames, which are hinged at each end into the top of the stem and stern post. These longitudinal frames are broad and flat, and made of the best Canadian rods clan. They are bent over suitable moulds by steaming, and when the boat is folded up they lie flat against the centre framing of stem keelson and stem post like leaves of a book. Over these longitudinal frames, when projecting outwards at definite and suitable angles, is stretched the framework of canvas.

When first Mr. Berthon endeavoured to introduce his collapsible boat in 1850, and successive years, it was supposed that india-rubber sheeting was the only effective water-proof material with which to form the shell of the boat. After, however, the greatest care had been taken to select the best possible class of india-rubber, and the first samples had been constructed of it, it was found after the boat had been lying folded up for some time, and had been carried out to tropical climates, that they would not open, in consequence of the india-rubber having thickened by the heat, and consequently diminished in length. This was for many years a great blow to the inventor, and it was not until Mr. Plimsoll agitated so energetically for increased security to shipping and life-saving apparatus, that Mr. Berthon commenced further investigation as to a better material for his boats than india-rubber. His experiments were successful in discovering that the best quality canvas, saturated with a mixture of paint and soap, would answer the desired end admirably, resisting both heat and cold, and at the same time being perfectly water-proof.

The method of constructing the covering now in use is to stretch canvas segments prepared as above over the longitudinal frames. The segments are securely attached to the frames by copper tacks and white and red lead cement, and similarly also to the keelson and up the stem and stern post. A second skin of the same kind is now put on over the first, and fastened in the same way. Half-round beadings of wood are now put over all the tacked joints, and an outside keel stem, &c., are put on. This now forms a boat of very great strength and immense buoyancy, but still liable to fill and sink if these skins should be pierced. The longitudinal frames are, however, very broad though thin, projecting inwards from the outside canvas as much as 14 inches in a 30-foot boat. On the inner edges, then, of the longitudinal frames, are also tacked another inside skin of canvas as before, thus giving a hollow air space over the whole of boat between the inside and outside skins. And further this air space is divided into separate compartments by the longitudinal frames, so that even if one or more are pierced but a small portion is flooded. The boat thus becomes a perfect life boat, much more reliable than the ordinary ship's boat. This is testified by one of the testimonials we have seen, in which it is stated that when the boat had been put off through five lines of breakers sufficient to fill the boat she was not unmanageable, but fully justified her appellation of lifeboat.

The air has to find its way into these compartments when the boat is opened and out again when closed by small openings, provided at the top of each end. The bottom boards thwart stem and stern sheets are all jointed to the inner edges of those ribs most suitably placed to support them, and being also jointed in the middle they rise upward when the boat is folded as the ribs and shells fall downward. This arrangement has the advantage that all the interior pressure of the occupants serves to keep the boat fully distended or open when in use.

The gunwale struts are also jointed, and are hinged by alternate straps and links at once simple and effective. The masts step upon the keelson, and the rudder is hung in the usual way. Any proportions or lines can be followed on this system, and boats have been constructed small enough for a single boy and large enough to carry 200 men, horses, and artillery, &c. We are glad to see that Mr. Berthon's excellent invention is being largely patronised both by Government and by private owners. Up to within the last twelve months the building of the boats was carried on by Mr. Berthon himself, but now, as the business has so much increased it is carried on by a limited company, and about forty hands are kept regularly at work. From the peculiarly portable nature of the boats they can be constructed with ease at an inland town such as Romsey, and can be delivered by railway as ordinary goods. A boat 9 ft. by 4 ft. will shut up into a space of 6 in. in width, and a boat 21 ft. by 8 ft., giving a capacity for forty men, weighs about half a ton and collapses into a width of 17 in.

HER MAJESTY'S SHIP "MERCURY."

After no fewer than four disappointments from the boisterousness of the weather, the despatch-vessel Mercury succeeded in making a manufacturers' six hours' trial of her machinery on Sept. 1st. The results of a previous six hours' run has already been recorded in our last number; but, although the horse-power developed on the occasion and the working of the engines proved satisfactory to the Admiralty officials, yet, as the mean indicated power did not quite come up to the contract, the manufacturers, Messrs. Maudslay, Sons, & Field, resolved upon undertaking another power trial. Subsequently a speed trial was made upon the measured milein Stokes Bay for the special information of the Admiralty, when the power indicated rose to 7,513·95 horses, the number above 7,000 being in excess of the contract, and the marvellous speed of 18·876 knots per hour was realised. This, it might have been thought, would have satisfied the contractors, for, although a six hours' run previous to taking over new engines is now the rule of the service, the covenant with Messrs. Maudslay was negotiated before the long test of endurance became the regulation ordeal, and when, of course, the old mile trial held good. The makers, however, were not content with the satisfaction of all legal obligations, but were anxious that the machinery of the Mercury should prove in every respect equal to the performances of that of the Iris. The result of the six hours' full-power run yesterday more than justified the expectations of the contractors. The weather was all that could be desired. There was no wind save what the ship made in passing, and the sea was as smooth as a duckpond. In the after part of the trial the wind somewhat freshened, but at no time did it exceed the figure 2, and might, consequently, be thrown out of the calculations. Captain Wells, of the Steam Reserve, took command of the ship, and the trial of the engines, which was conducted by the Hon. George Duncan and Mr. Warrener, on the part of Messrs. Maudslay & Co., was watched by Mr. J. Oliver, from the Admiralty; Mr. Charles Icely, inspector of machinery; and Mr. A. Durston, of the Factory Department. The Mercury left Portsmouth harbour at 8 o'clock, being piloted out by Mr. Compors, and having rounded the Warner and the eastern side of the Isle of Wight she made a straight course for Portland. At a quarter to 9 the fires of the furnaces were burning with intense heat, care being taken on the present occasion to use nothing but Nixon's steam navigation smokeless coal; and, as a full head of steam had been obtained, the half-hourly observations were begun as early as a quarter to 9. Portland was reached at 45 minutes past 11, being the quickest passage on record. The ship was then turned round for the three hours' homeward run, the tide being against her in both directions. A large circle was made in turning in order to reduce the grind upon the engines as much as possible, but, as will be seen from the following series of observations, the helm nevertheless exercised a very appreciable deterrent effect upon the engines, a couple of revolutions per minute being lost in going round:—

Steam in Boilers.	Vacuum.		Revolutions.		Indicated Horse Power.		Total Ind. Horse Power.
	S.	P.	S	P.	S.	P.	
66	27¾	27	95·87	94·53	3852·23	3679·21	7531·44
65½	27½	27	98·20	96·66	3875·45	3756·31	7631·76
65	28	27	97·13	96·00	3821·59	3643·98	7465·57
66	27½	27	98·20	96·73	3901·38	3738·32	7639·70
65	27½	27	97·53	96·00	3816·14	3616·24	7432·38
64	27	27	97·13	95·70	3786·50	3606·45	7392·95
61½	27	27¼	95·90	94·90	3588·66	3443·90	7632·56
64	27	27	96·36	94·83	3670·01	3532·59	7202·60
65½	27¼	27	97·00	95·56	3762·63	3645·54	7408·17
62¼	27	27	95·70	94·66	3639·49	3381·72	7021·21
62½	27	27	96.03	94·77	3654·34	3439·19	7093·53
59	27¼	27¼	94·43	93·11	3459·45	3272·86	6732·31

It will thus be seen that the *maximum* power developed at any time during the trial was 7,639·70 horses, and that, near the conclusion of the run, dirty grates and exhausted energy on the part of the stokers (who had to work in an atmosphere rising occasionally to a temperature of 140°) produced the inevitable result in loss of steam, revolutions, and power. The vacuum was remarkably high and regular from first to last. The following are the means of the six hours:—Steam in boilers, 63·87 lb.; vacuum, starboard, 27·29 in.; and port 27·04 in.; revolutions per minute, 96·66 starboard, and 95·26 port; mean pressure of steam in cylinders, starboard, high, 41·77 lb., low, 11·56 lb.; port, high, 40·46 lb., low, 11·18 lb.; indicated horse-power, starboard engines, 3,735·65, port engines, 3,563·02; total indicated horse-power, 7,298·68, or nearly 300 horses beyond the contract. The Iris at the six hours' trial attained only 7,072 horses. The mean speed realised by the Mercury during the entire run reached 18·6 knots per hour. This marvellous speed has been excelled both by herself and her sister ship on the measured mile, but on no occasion has so high a rate of speed been maintained for so long a period. The working of the machinery and boilers was in every respect satisfactory. The quantity of coal consumed during the trial amounted to 1,044 cwt., giving 2·72 lb. to every unit of horse-power developed. In the Mercury cast iron of additional strength has been substituted for the wrought-iron guides of the piston-rod heads in the Iris; and in both ships considerable mechanical ingenuity has been requisite to keep the vital parts of the engines below the water line. The boilers are fitted with automatic stop valves. Should a boiler, therefore, be pierced by shot in action, the valve would close of itself and the steam from the other boilers be prevented from escaping through the shot holes. The valves would also be of service in case of boiler explosion. The Mercury will now be brought forward for commission, measures being at once taken to provide her with three steel masts, carrying fore-and-aft and light square sails.

SHIPS' PUMPS.

WHAT is more alarming on board vessel than the cry of fire. The whole crew and all the passengers are at once thrown into the greatest consternation, and though all are willing to do what they can to subdue the flames the difficulty is to employ their assistance usefully. In such cases the old-fashioned hand fire engines would be just the thing to utilise any amount of willing power, and at the same time be so simple in use that all the world might use them without any instruction whatever.

We illustrate this month some specimens of hand fire-engines made by Hayward, Tyler, & Co., which would prove just the right things under such circumstances. Fortunately, there is never any lack of water in a fire at sea, so only pumping power and hose to direct the jet are required. Even in the cases where steam fire-pumps are fitted in the vessel, these might easily be temporarily disabled by the valves being choked, and in such circumstances hand-pumps would be invaluable. This is so universally recognised in Her Majesty's Service, and in the Merchant Service, that hand-pumps are very largely used to supplement the use of donkey steam-pumps.

Fig. 1 before us is arranged so as to be easily secured to the deck. The barrels are single acting, with a large air-vessel between them. This air-vessel by its elastic action gives a very regular and uniform stream of water. The valves are of the simplest clock construction, so that they can be examined and repaired at once by removing the screws which fix the barrel to the bottom plate. By an ingenious addition of a top rod, this pump may be worked on any of the under decks, by carrying up the rods and handles to the upper deck. In that way a very considerable number of hands may be put to work these pumps.

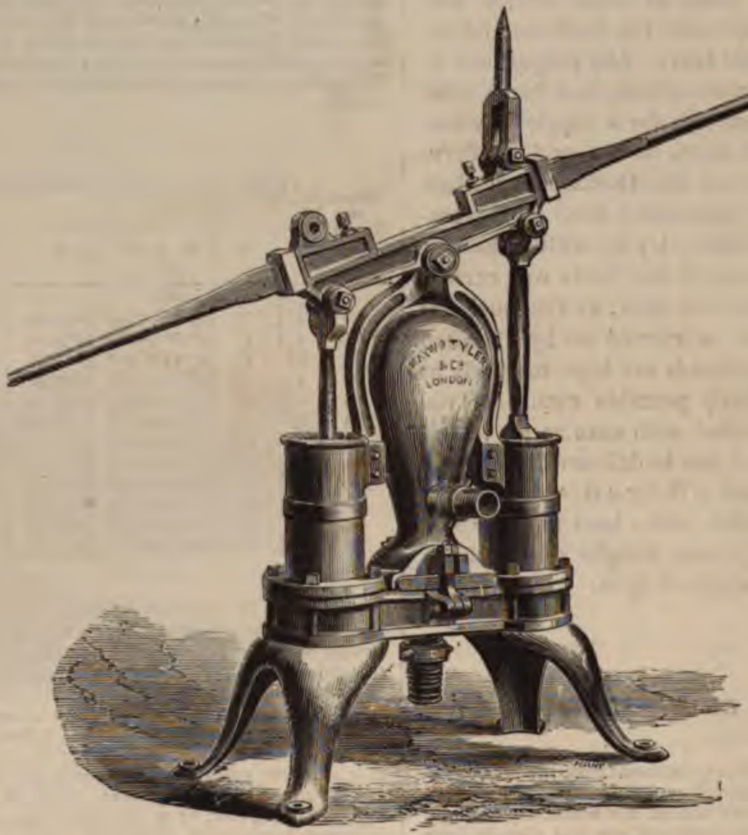


FIG. 1.

Fig. 2 is the pump that is largely used by the Peninsular & Oriental Steam Navigation Co., and it has the peculiarity that the handles do not work up and down, but forwards and downwards simultaneously, describing an arc round a centre pivot. All the valves bearings, &c., are and should be of gun-metal in pumps of this description, in order that they should be attacked as little as possible by the sea-water.

In addition to protection against fire, these pumps are applicable to a considerable number of other useful purposes. They may be used for deck-washing or in case of leakage they would become very valuable auxiliaries to help and keep down the water from rising too rapidly. Much is said now-a-days about the perfection of our ironclads and largest merchant steam-vessels on which everything is done by steam power, but in our opinion there is a great safety in the older-fashioned hand processes, where we are not dependent for safety so much upon the accuracy and strength of an infinite number of small mechanical details, any one of which may render the steam-moved machine useless.

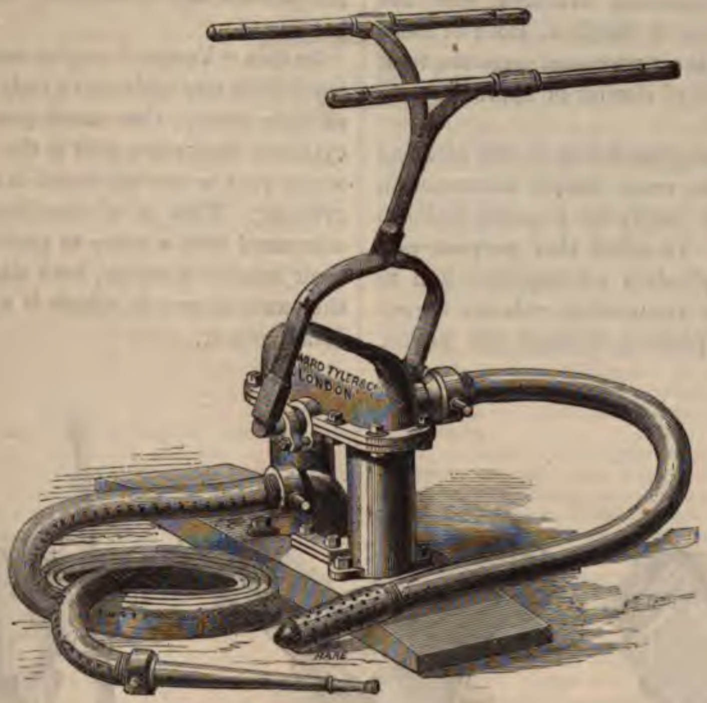


FIG. 2.

THE AIR IN SEA WATER.

IT is only in recent years, and through the well-equipped expeditions that have been engaged in exploring seas, that the question as to the amount and composition of the air in water has been systematically treated. Important researches of the kind were carried out by Herr Jacobsen on the Pomerania, in the Baltic and North Sea, one result of these being that the proportion of oxygen in the air of surface water was found pretty constant between 33·64 and 34·14 per cent. Again, Mr. Buchanan, of the Challenger expedition, found it to vary between 33 and 35 per cent., the largest proportion being in the neighbourhood of the South Polar Circle, and the least in that of the trade winds. A new study of the question by Herr Svendsen and Herr Ternöe, in connection with Norwegian expeditions to the sea between Norway, the Faroe Islands, Iceland, Jan Mayen, and Spitzbergen, has recently appeared. In some respects former methods of procuring the water and of analysis were improved on, and laboratory experiments were made as to the absorption of air by sea water. These observers got higher numbers for the surface proportion of oxygen than were obtained in the North Sea; thus, south of 70° latitude the average was 34·96; and between 70° and 80°, 35·64 per cent., instead of 33·93 per cent. This corresponds, however, with what Mr. Buchanan met with in the latitude of the Antarctic Circle—viz., 35 per cent. It appeared further, that the oxygen in the surface water was always considerably greater than as found by laboratory experiment; so that, apparently, it does not depend alone on pressure and temperature, but also on some still unknown causes. The decrease of oxygen with the depth is thus expressed:—From an average of 35·3 per cent. at the surface it decreases, at first quickly, then slowly, till at 300 fathoms it has become 32·5 per cent., and it remains pretty constant at this in greater depths. With regard to nitrogen, it was found that the proportion at any depth depended only on the prevailing temperature, and could be easily calculated from a formula determined by experiment. (Mr. Buchanan's *data* for nitrogen at different depths also agree with the values calculated by Herr Tornöe's formula.) The authors are led to point out the probable impossibility of differences of temperature and pressure producing in the under layers a different distribution of air from that existing since the time when the water was last at the surface and exposed to the atmosphere. Nor would mere mixture disturb the relation between temperature and proportion of nitrogen. Hence, by a determination of the nitrogen in different layers of the sea-water, one could roughly determine whether it had undergone heating or cooling since it was last at the surface, supposing the action of varying atmospheric pressure and other accidents during absorption at the surface might be neglected.

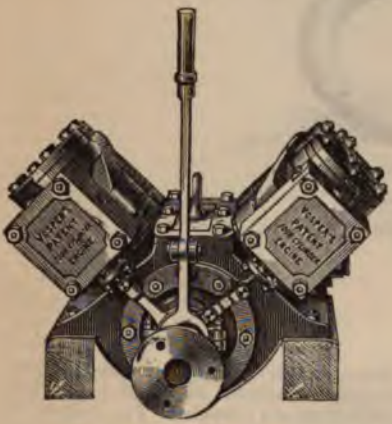
ENGINEERS.—On Friday evening, September 5th, a further meeting was held of Sea-going Engineers at Newcastle, and a branch was formed, attached to the United Kingdom Association of Sea Engineers. There was a large number of men present who signified their intention of becoming members, and the branch is to hold weekly meetings to promote the object of the society.

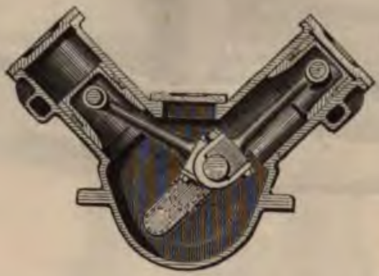
WITH reference to the *souvenir* which is to be made out of some of the best of the timbers of the old Arctic ship Resolute and presented to the President of the United States, by which country the vessel was presented to the British Admiralty after she had been abandoned in the Arctic regions, she having subsequently been recovered by an American whaler, three designs have been submitted to the Admiralty for their Lordship's selection. It is expected that the design which will be selected will be one of a handsome secretaire, which will be rich in design and workmanship, and several of the figures upon which will be symbolical of the good feeling existing between the two nations.

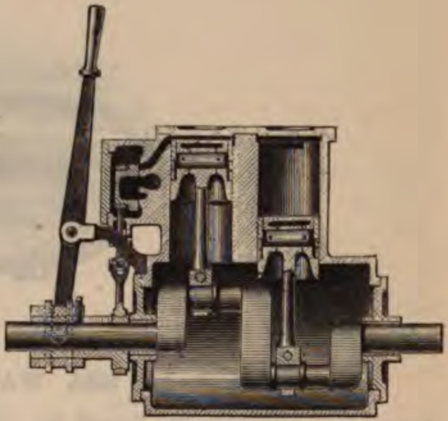
THE "VOSPER" FOUR-CYLINDER ENGINE.

THERE is still an unsatisfied demand in the market for a good fast speed launch engine. The "Brotherhood" three-cylinder engine was one of the first to be put on the market and the next that followed with any special distinguishing features was the "Willans," made by Hunter & English. Both of these engines were excellent in their way, and were the forerunners of a large number of similar or approximately similar designs.

What is sought is an engine which in the smallest possible space and of the most simple construction shall keep a pressure as nearly as possible uniform upon the rotating crank. To effect this purpose well at least three or four cylinders are requisite, and to render them compact the connecting rods are invariably centred on a pin passing through the piston.


VOSPER'S PATENT FOUR CYLINDER ENGINE
VOSPER'S PATENT FOUR CYLINDER ENGINE





The advantages of this system are obvious in the matter of reducing the space required, but at the same time the great lateral thrust thus induced on the pistons tends to great wear on those parts and considerable friction in the cylinders.

The "Vosper" engine, which we this month illustrate, has most of the usual features common to the multiple cylinder engines, but also some distinctive and advantageous features. The cylinders are four in number, arranged in two pairs at right angles to each other. This gives a very uniform and regular pressure on the crank, which has two throws, on each of which operates one engine from each side, the throws being opposite to one another.

This arrangement of cylinders brings the weight very low down and yet has no cylinder underneath the crankshaft, which can thus be fitted in an exceptionably low position in the vessel or launches. The compression pistons and connecting rods are of course used to enable the engine to run at a very high speed without noise of any kind. That is to say, all the cylinders are only single acting, and the work is thus all done by the alternate pressure of the steam on successive pistons. There is always sufficient back pressure or "cushion" on the exhaust stroke to keep the pistons and connecting rods home on the crank bearings.

In this "Vosper" engine each pair of cylinders is worked by one slide valve only of the ordinary 3 port or slide valve. One steam port leads to the nearest cylinder, the centre port is the exhaust, and the other steam port is carried round in a pocket to the second cylinder. This is a considerable economy of parts compared with a valve to each cylinder, and owing to their relative position, both slide valves are worked by the same eccentric, which is again a very simplified arrangement.

Owing also to the arrangement of the cylinders in pairs, and that each pair is operated by one valve, it is very easy to compound each pair, and thus, when their size is sufficient, to render them very economical in the use of steam.

It is well known that one of the chief objections to many of the multiple cylinder high speed engines has been the use of cone or plate valves, which in the case of the former never wear true, and in the case of the latter offer too much friction to rotation from the large area under pressure and the high speed of movement.

The application in the "Vosper" engine of the ordinary slide valve which has so little relative motion, and is known to wear so well, may be considered a special and distinctive advantage.

This engine is being brought out by Mr. C. R. Okes, of 39, Queen Victoria Street, who is the sole London agent.

HUNDRED-TON BREECH-LOADERS.

THE Italian Government have just ordered eight more 100-ton guns to be made by Sir W. G. Armstrong & Co., with this important fact involved, namely, that the guns will be breech-loaders. As a matter of course, the designs for these monster guns, with all that appertains to their method of working, must have been laid before the Italian authorities prior to the order being given for their manufacture. Hence it is certain that Sir William Armstrong is perfectly prepared to undertake the responsibility of constructing breech-loading guns of such extraordinary magnitude. There will be no departure from the coil system in the construction of these weapons, and, accordingly, we shall see the question brought to a practical issue, whether large breech-loading guns can be made on the coil system to compete with the steel breech-loaders of Herr Krupp. There is reason to believe that Herr Krupp expects peculiar difficulties to arise in the construction of a coiled breech-loader, from the fact, that if the breech is to be closed by a wedge, as in his own system, the coils must be cut asunder at the rear, thereby seriously reducing the strength of the gun at that part. If, to avoid this, some other mode of closing the breech be employed, failure is predicted by the giving way of the breech-closing arrangements. Thus if the French method is adopted, in which a screw plug is made to close the aperture, it is said that the force of the discharge will speedily break the screw threads. In respect to the Armstrong breech-loaders of recent date the French screw plug has been adopted, but in a somewhat improved form, and has been found to answer perfectly well. This method of breech-closing precludes the necessity of cutting into the coils, the bore of the gun being prolonged backwards, and the extra piece being constructed for the reception of the screw plug at the rear. The screw threads only travel round part of the circumference, and the arrangement is such that the plug is first of all thrust forward without rotating, and is afterwards blocked by a partial turn. Thus the movement is rapid and the mechanism is simple. In connection with the screw plug there is a contrivance equivalent in effect to the Krupp-Broadwell ring, but differing altogether in construction, which serves to prevent any escape of powder gas.

Eight 100-ton guns represent a tremendous armament. Each shot will start from the powder chamber with a pressure of about five thousand tons at its rear, and the energy stored up in the projectile as it leaves the muzzle will be equal to the raising of forty-four thousand tons a foot high. The penetrating force will be equal to three feet of armour at close quarters, with proportionate reductions, according to distance. These data are founded on the performance of the muzzle-loading 100-ton guns made by Sir W. Armstrong, four of which have passed into the possession of the British Government, having been purchased out of the vote of six millions. The guns thus purchased by England were made for the Italian Government, but, as the latter were not ready to make use of the weapons, our own Government was permitted to purchase them. The Italians have profited by the transaction, for it has enabled them to complete their quota of 100-ton guns by having breech-loaders instead of muzzle-loaders. They will have eight muzzle-loaders for the armament of the Duilio and Dandolo, these vessels carrying four each; and they will in like manner have eight breech-loaders for the Italia and Lepanto. The muzzle-loaders already supplied are characterised, like the Krupp guns, by great length of bore, and of course this feature will be maintained in the breech-loaders, if not further developed. How far this principle has been carried by Sir W. Armstrong will be seen in the fact that while the Woolwich 80-ton gun has a bore only eighteen calibres long, that of the Armstrong 100-ton gun is between twenty and twenty-one calibres in length. But even the 80-ton gun is proportionately longer than the Woolwich 38-ton gun, the latter having a bore of only sixteen calibres.

The four 100-ton guns purchased for the British service are destined to be employed for coast fortifications, the localities specified being Malta and Gibraltar. But the Italians will carry their 100-ton guns on shipboard. It is evident that this inequality will have to be rectified. But time must elapse ere the change can be made, for we have no ship in hand which appears capable of being adapted to the tremendous task of carrying four 100-ton guns. The Inflexible could have borne the burden, but she has been fitted for the reception of four 80-ton guns, and it is scarcely likely that she can be adapted to the carrying of the long 100-ton guns, except at an extravagant expense. One fact of some interest is that the new Italian guns are to be so mounted as to admit of their being loaded either at the breech or the muzzle. Possibly some ingenious critic will object that this involves a risk of a gun being accidentally loaded at both ends, so as to bring about a result no less surprising than the loading of the Thunderer gun twice over, and still more disastrous. The chance of such an occurrence, we may presume, is exceedingly remote, and may fairly be disregarded, while the advantage of an alternative arrangement is undeniable. We may thus look forward to the possession by another Power of four immense iron-clads, all carrying guns of greater efficiency than those of the Inflexible, and two ships out of the four having guns of the breech-loading type. The Italia and Lepanto will be the largest ironclads in the world, and probably the fastest, besides carrying the thickest armour and the most powerful guns.

It may be stated, with almost literal accuracy, that the science of artillery is advancing with giant strides. Not only has the method been discovered by which guns of enormous size can be constructed, but extraordinary progress has been made in the art of getting the utmost power out of a gun. The results at Meppen have created a feeling of surprise, but they are simply the embodiment of principles which have been worked out by a careful process of investigation, and which principles were already known, both at Woolwich and at Elswick. Nowhere has research into the science of gunnery been carried so far as at Woolwich. The value of long bores, of mild powder, and even of breech-loading, has not been hidden from the English authorities. That the steps taken for realising the advantages thus known to be attainable have not been more rapid is a circumstance only to be explained by the existence of that retarding friction which is apt to prevail in the Government service. A private manufacturing firm enjoys a freedom of action which is favourable to rapid changes. If all the facts were known, we should not be surprised to learn that Herr Krupp has been working by the light of experiments conducted at the cost of the British War Office.

The construction of the great breech-loaders for Italy by Sir W. Armstrong not only offers a practical reply to the challenge given at Meppen, but may be accepted as a refutation of the unfavourable surmises which were levelled against the Woolwich guns when the disaster took place on board the Thunderer. If that explosion had revealed any weakness in the coil system of construction, it is not likely that Sir W. Armstrong would now commit himself to the onerous task of making 100-ton breech-loaders on that system. Captain Andrew Noble, who is a fellow of the Royal Society, and a member of the Elswick firm, and who was also associated with Professor Abel in the official researches on "fired gunpowder," was a witness before the Thunderer Committee, having made himself thoroughly acquainted with the circumstances of the explosion. It is a perfectly fair inference that unless Captain Noble had been completely satisfied that no inherent weakness in the Woolwich gun caused it to burst, the Armstrong firm would not now be undertaking to make breech-loading coil guns of 100 tons. It may be asked why, if all is so clear and satisfactory, the country should be put to the expense of any further inquiry into the nature of the recent explosion, and into the general efficiency of the service guns. A reply is furnished in part by a reference to the Report of the Thunderer Committee, which concludes with the following recommendation: "That in order to restore confidence in guns similar to that which has exploded, the fellow gun should be sent to England, and should then be subjected to a series of tests, and should be finally loaded and fired with a double charge, similar to that which the Committee are convinced burst the left gun of the fore turret of the Thunderer." This was a proposal made outside the limits of the instructions given to the Committee, and confessedly so. The suggestion was designed to afford the public a practical demonstration which should remove any doubt as to whether or not the Committee were right in their conclusions. At the time when it was made such a proposal seemed very reasonable, but, in the light of present facts, the testing of the 38-ton gun to destruction seems little better than a waste of money. Everybody seems satisfied now as to the real cause of the explosion, and the most that can be done is to show that the gun could not have been burst by any other contingency likely to occur to it. There is, however, a committee appointed to carry out a series of experiments with the gun which has been returned from the Thunderer, and a promise was made in Parliament that there should be a general inquiry into the gun question. The Committee, with General Gordon at its head, bears the designation of a "Committee of Ordnance," and is expected to go into the question as to the relative merits of breech-loading and muzzle-loading, presuming its members are, in the first instance, satisfied that the coil system is to be retained. That they will find any reason to distrust the Woolwich system is altogether unlikely. It is equally improbable that they will feel justified in recommending any other system in preference. That they will recommend the employment of breech-loading, more or less, is tolerably certain, but how far they will enter into details cannot at present be asserted. The Committee has been appointed at a critical period, and we can only hope that the experiments to be conducted with the 38-ton gun will assist in deciding other questions besides the catastrophe on board the Thunderer. The "bursting cell" in course of construction in front of the proof butts at Woolwich is expected to be ready in about five weeks, and no doubt the experiments will speedily follow.

NORTHERN SHIPBUILDING PROSPECTS.

ONE of the chief of the Northern industries is that of shipbuilding, and for the last two or three years it has proved the mainstay of the Northern iron trade. When the iron rail trade of the North collapsed, it was fortunate that the low prices of iron tempted shipowners to enlarge their holdings; and that there were a series of contracts placed in the North of England the fulfilment of which has ensured full labour in the shipbuilding yards, and brisk work in the plate and angle mills, down to the present year. But since the last half of the year set in there has been less activity in the iron trades, from the lessened orders for new vessels; and the dulness in the ship-yards has contributed materially to the distress which prevails in the North of England. There has been for many years a tendency towards the increased use of iron in shipbuilding; and this to such an extent, that iron vessels are now more than ever the rule and wooden vessels the exception; whilst steamers are built not only of larger tonnage, but of tonnage and numbers far in excess of sailing vessels. In 1860 we use to build iron vessels to the extent of 64,699 tons, but the annual number of vessels since then has been trebled, and the tonnage is multiplied sixfold. Of course, with this increased and increasing tonnage there is a larger amount of loss, and there is a replacement needed of the many wooden vessels which are struck off the register and which are not replaced by wood. Very naturally there has been, since the growth of iron shipbuilding, a great growth of shipbuilding in the great Northern iron district. On the Wear the number of vessels built is less than it was in the days of our wooden walls—the number being, for the last few years, only one-half of what it was thirty years ago, but instead of the vessels being of an average of from three to four hundred tons, they are now from eight hundred to eleven hundred tons, and the total tonnage turned out is double what it was in the earlier days of wooden vessels. On the Tyne, also, iron shipbuilding has largely grown, and it may be now said to be the premier constructive industry; while the Tees, with a tonnage built annually of from thirteen thousand to twenty-three thousand tons; West Hartlepool, with yards which last year built vessels to the extent of forty thousand tons; and Whitby, where ten thousand tons of iron vessels were built, add largely to the productive capacity of the district.

It must not be supposed that all the plates and angle-iron made in the Northern iron manufacturing district are for the local shipyards; but the great bulk unquestionably are. And the effect of the prosperity of the shipbuilding trade was apparent in the increased output of plates and angle iron by the associated makers in the North of England; for whereas in the brisk year of 1872, when the iron rail trade of the North was most animated, the plates made by the associated makers were slightly less than 180,000 tons, last year some 234,000 tons were produced. When to this the production of angles of about 90,000 tons is added, those familiar with the figures will know that the output of iron chiefly for shipbuilding purposes represented the great bulk of the manufactured iron produced in the North. Plates, indeed, formed in 1872 about 30 per cent. of the total sales of the associated makers; but now they form over 59 per cent., and the proportion of angles made has also been increased; and with those increases the dependence on shipbuilding of both the malleable iron trade of the North and of the parent crude iron industry has been enlarged. There can be no doubt that there must have been a very great stimulus of trade in consequence of the very low prices that have prevailed and still prevail for shipping. Had it not been for these low prices it is tolerably certain that there would not have been so large a construction, for the freight market has been low, and dividends received by owners of vessels have also declined. The price of iron vessels fell to about £10 10s. per gross register tonnage, and though there may have been some slight recovery from this minimum price and prices still tend upwards as pig iron rises, yet the rates quoted are still almost unprecedentedly low. But the ultimate determinator of prosperity in the shipbuilding trade is the state of the freight market, and as, during the earlier months of the present year, this was not promising but declining, the amount of iron ships in progress dwindled, and in many of the chief centres of the trade in the North it fell off so rapidly that now not one half of the launching berths are occupied. If the increase in the price of iron continues it is probable that there will be a recovery of animation in the industry, for we lose yearly from 70,000 to 100,000 tons of our iron vessels at sea, and we have to renew that loss and that of the wooden vessels to keep up our merchant fleet at its present extent; so that continued activity in our shipbuilding yards is needed. In other words, to supply the loss by wreckage, &c., of our iron vessels alone we need to build a fourth of the ships we have lately built; and there is a further proportion of iron vessels needed annually to replace the obsolete wooden vessels that are broken up and otherwise removed from the register, while the expansion of the carrying trade of the world calls for no small proportion of the remainder.

Possibly in the years of briskness in the iron ship-building trade there was a construction in excess of the normal needs of the nation, but it is certain that in years such as 1873 there was a construction below those needs, for the iron vessels lost were about a third of the iron vessels built, and there was a large removal of unreplaced wooden vessels also, and at the present time the constructive powers of the ship-building yards are far from fully occupied. For example, it may be said that on the River Tees at the present time the number of vessels in course of construction is not a third of what it usually is; and all the ship-building centres of the North have found this dulness, as the records of the tonnage launched during the present year will in a few months show. The evil, therefore, of over-construction, or, perhaps, the response to a falling demand, is promptly checked or given. For months that dulness in the ship-building trade has been showing itself, and any excess of tonnage is being now remedied. It is probable, however, that there will now be a slight renewal of activity; but it may be in a changed manner, for there is developing an enlarged demand for steel vessels. In the merchant navy this is comparatively a new feature, but during the last two years great progress has been made, and the probable use of steel from cheap Cleveland ores will facilitate that progress. The great obstacle in the way of the use of steel for merchant vessels has been its cost, for the steel used has been as nearly as possible double the price of iron. The lessened quantity of metal, and the larger carrying capacity of the vessel have been now recognised as at least a partial recompense for the increased first cost, and there is now a decided tendency towards the use of steel. In the future, therefore, there may be a substitute of steel for iron in shipbuilding as there has been on railways; but whether the shell be of the newer or the older material, it seems probable that in the North of England there will for a time be an increase of business in the construction of vessels. There will be, of course, a very material effect on the local iron trades as steel comes into more general use, but that effect is now being discounted; and by the construction of works for the manufacture of steel plates and angles the Northern district is preparing for what seems inevitable, but for a change which will be gradual, and may be distant in its completion.—*Standard.*

NEW HARBOUR WORKS AT DOUGLAS, ISLE OF MAN.

FOR several years past engineering operations on a large scale have been prosecuted with considerable vigour at Douglas, in the Isle of Man. These operations have reference to the construction of a new breakwater and pier, which was opened for public use on August 29. To those unacquainted with the locality, however, it may be interesting if, before describing the structure, we revert to the circumstances which led to the formation of the present harbour works. The Royal Commissioners on Harbours of Refuge (1859), when reporting on Manx harbours generally, after pointing out the necessity which existed at Douglas for shelter for vessels engaged in the passing trade, went on to say that protection was also required "for the security of the inhabitants of the island, who, in the ordinary pursuits of life, are now exposed to considerable risk, from being under the necessity of embarking and landing in open boats at its chief port. We may further add, it has been clearly shown that great inconvenience and loss result from the want of a certain communication with the neighbouring commercial ports and the seat of Government, arising entirely from deficient harbour accommodation. Douglas is the place of the greatest trade and importance, and between this port and Liverpool lies the line of communication for passengers and mails. The harbour is not only insufficient in extent, but is exposed, and often dangerous." For these evils a complete remedy has been provided by the new works now to be described, and it may here be added that henceforth the Isle of Man is to have the benefit of a mail in both directions daily (Sundays excepted) throughout the year.

On the accession to office of Governor Loch no definite plan appears to have been decided upon. Rightly regarding the Douglas Harbour question as one of paramount importance to the whole insular community, Mr. Loch applied himself to this among other pressing matters, and under the professional advice of Sir John Coode, C.E., designs were prepared for entirely new and extensive works to be constructed of Portland cement concrete, seaward of the whole harbour, which was, and of course still is, altogether dry at low water. Briefly described, these new works are as follows:—The first portion in order of time was the structure which since its completion has, by her Majesty's permission, been called Queen Victoria Pier. This work extends from the shore at the south end of the town of Douglas, and runs about 1,100 ft. in a south-easterly direction. It is 50 ft. wide at the top, and has a depth of 13 ft. at low water spring tides alongside the inner berths and 20 ft. at the outer, the respective depths at high water being 34 ft. and 41 ft.; there is landing accommodation for steamers on each side, and six sets of steps are provided. Queen Victoria Pier was completed and brought into daily use in 1872, and since that time the number of visitors to the island has been annually increasing.

The outer pier, which serves also as a breakwater in affording protection against the violent seas to which the bay is exposed, commences just within the promontory known as Douglas Head, the starting point being immediately under an old War Department battery; it has hitherto been known as the "Battery Pier." An impression seems to prevail, however, that this structure will in due course receive some other appellation. This Battery Pier, which was yesterday devoted to public use, is approached on the south side of the harbour by a roadway supported by a well finished and substantial concrete revetment wall upwards of 2,000 ft. long, founded on rock, and rising in some portions of its length to a height of 35 ft. above low water. Seaward of the old harbour this wall will serve also as a quay for the accommodation of vessels. The pier from Battery Point is about 1,000 ft. long, measuring from the face of the quay wall last described, or nearly 900 ft. beyond the original low-water line. This structure is of a massive character, and seems well adapted to resist the very heavy seas to which it is exposed in south-easterly gales. The outermost portion is of solid masonry throughout, formed of heavy concrete blocks. To give an idea of its substantial character, it may be mentioned that this part of the work is about 55 ft. wide at the bottom and nearly 70 ft. wide at the extreme end; the total height of the solid masonry from the sea bed to the parapet is just 80 ft.; the depth of the inner berthage is 18 ft. at low water, and at the outer berthage 26 ft., the respective depths at high water being 39 ft. and 47 ft. At the northern extremity or head there is a neat and substantial concrete lighthouse tower. The focal plane of the red light exhibited in it is 52 ft. above mean sea level.

The works, as already observed, have been constructed entirely of Portland cement concrete blocks. They have been executed from the plans of Sir John Coode, as engineer in chief, under the direction of Mr. William Powell, as resident engineer, and without the intervention of a contractor. The total cost has, it is stated, been but slightly above £150,000.

THE RIVAL GREAT GUNS.

THE most remarkable achievement of the 80-ton gun was accomplished yesterday at the Royal Arsenal proof butts, Woolwich, one of the monster weapons constructed for the Inflexible, and recently enlarged, contriving not only to beat all the previous performances of itself and family, but also to eclipse the doings of the great German gun which Herr Krupp designed purposely to outrival the Woolwich Giant. Herr Krupp's gun, being made of steel, a material in which the generality of English gunmakers have insufficient faith, is necessarily less ponderous than the wrought iron guns, whose immense coils, shrunk one upon another, afford the combined tenacity and elasticity in which the British artillerists place such strong reliance. Although it is considerably longer than the 80-ton gun, it is 10 tons less in weight. In calibre the guns are nearly alike, the German gun being 15.76 in. in the bore, while the English gun has just been increased from 15½ to 16 in. The great length of the former was thought to give it a paramount advantage, and in scientific quarters the results of the late trial at Meppen were almost a foregone conclusion. Firing a projectile of 1789 lb., with a powder charge of 451 lb., Krupp's registered a muzzle velocity of 1,648 feet per second, which is calculated as equivalent to an energy of 32,322 foot-tons, or the penetration of 32 inches of iron armour. The War Office authorities could not conveniently lengthen their guns, but they had been long convinced that the weapons had latent powers to be developed, and no time was lost in setting about improvement. Besides enlarging the bore the order was given still further to scoop out the chamber, and by this means space was obtained for the effectual and deliberate consumption of the comparatively "slow" gunpowder which experience has proved to be of the greatest service in these enormous charges. The powder was carefully compounded, particular attention was paid to the air spacing of the cartridge, and altogether it was hoped that if the performance did not quite equal that of Meppen it would not fall far short of it. Yesterday one of the altered guns—and they are all precisely alike—was fired, and the results were astonishing. At the first round, which was merely a "warmer," with 425 lb. of powder, the velocity of the projectile was 1,603 feet per second, and the projectiles weigh rather above 1'760 lb., or about the same as that of Herr Krupp. The full charge of 445 lb. of powder was then fired, and the electric recording instrument marked a velocity at the muzzle of 1,657 feet per second, or a fraction of nine feet in excess of the German gun's velocity under almost precisely similar conditions. The officials engaged on the trial, to satisfy any doubts which might exist as to the accuracy of the test, again loaded the gun exactly as before, and again the speed of the great bolt was given in the instrument room as 1,657 feet per second. The other 80-ton guns have to be tried under similar conditions; but no doubt exists as to their acquitting themselves with equal credit.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES (ENGLISH).

Mandovi and Bengo.—Messrs. Laird Brothers, of Birkenhead, have recently been constructing two gun-vessels for the Portuguese Government, the first of which, named the Mandovi, was launched from their works on Saturday, the 16th, and the second on the 3rd of August. The latter is named the Bengo. The ceremony of naming the Mandovi was performed by Miss da Costa Ricci, daughter of Mr. A. J. da Costa Ricci, secretary to the Portuguese Financial Commission; and the Bengo was christened by Madame Diniz, the Government of Portugal being on each occasion represented by Captain P. Diniz, of the navy of that country. The length of the two gunboats is 123 ft., and the breadth 24 ft., with a depth in hold of 11 ft. 4 in., and a tonnage of 339. They are built of iron, and completely sheathed externally with teak 2½ in. thick, which will be again sheathed with zinc up to 12 in. above the water line in the manner adopted for some of the recently-built vessels of the British navy. Each vessel will be armed with one pivot Armstrong and two 20-pounder rifled guns.

Vigilant.—Mr. John Harvey, Yacht and Shipbuilding Company, launched from their yard at Wivenhoe, on August 23rd, a new Trinity pilot-boat of 120 tons, named the Vigilant, to replace the Edinburgh, which was run down off Dungeness last spring.

Gannet.—On Sept. 1 Messrs. M. Pearse & Co. launched from their iron shipbuilding yard at Stockton-on-Tees, an iron screw steamer of the following dimensions:—Length between perpendiculars, 245 ft.; extreme breadth, 33 ft.; depth of hold, 17 ft. 9 in.; and measuring about 1,260 tons gross. This steamer is classed 100 A 1 at Lloyd's, and is fitted with accommodation for about 60 first-class passengers in a spacious saloon, and between 30 and 40 second-class passengers in a roomy cabin forward, both of which are replete with all the most recently-introduced appliances for the comfort and convenience of the passengers, and the sanitary arrangements are of the most perfect description. Very complete and approved provision is also made for the conveyance of horses and cattle, which are likely to form a considerable item in the trade for which she is contemplated. The gear for the speedy loading and unloading of cargoes, consisting of four steam cranes of very considerable power, and two double-cylinder steam winches, is most complete, and the builders have availed themselves of all the latest improvements made therein. She is also provided with horizontal steam-steering apparatus (Bow and M'Lauchlan's), of great strength, placed in a teak house built on the bridge. The engines, which are on the compound principle, are of 150 horse-power nominal, and are being built by Messrs. Blair and Co., of Stockton. This vessel is built for the General Steam Navigation Company, and is the sixth steamer Messrs. Pearse & Co. have built for that Company. As she left the ways she received the name of Gannet, this ceremony being performed by Miss Hingston, of Liskeard.

Gracie.—On Sept. 1 Messrs. Edward Withy and Co. launched from Middleton Shipyard, Hartlepool, an iron screw steamer, which has been built to the order of Messrs. Stephenson, Clarke, and Co., of London, under the superintendence of their consulting engineer, Mr. G. B. Barnard. This vessel is No. 83 in the builder's yard, and is the third built by them for the same owners. She is specially fitted for the Tyne and Thames gas-coal traffic, as well as for the Baltic trade, and has exceptionally high power for a vessel of her size. Her principal dimensions are:—Length, between perpendiculars, 261 feet; beam, extreme, 32 feet; depth of hold, 17 feet; and she will carry 1,800 tons of cargo, and bunkers on about 16½ feet mean draught. She has been built under Lloyd's special survey for the 100 A 1 class, and has long quarter deck, water ballast under both holds, topgallant forecastle and bridgehouse; will be fitted with three steam winches, a patent windlass, and iron deck for half length amidships, under the ordinary wooden deck. She will receive engines of 180-horse power, by Messrs. Blair and Co. (Limited), of Stockton-on-Tees. As she left the ways she was christened Gracie, in the presence of a numerous company.

Zoe.—On the 1st inst. a screw steamer intended for the general carrying trade was launched from the yard of Messrs. Palmer, Jarrow. The steamship, which was named the Zoe, is being built to the order of Messrs. Burdick and Cook, of London. She measures 230 feet between perpendiculars, by 31 feet in breadth, and 17 feet depth of hold. The Zoe is classed 100 A 1 at Lloyd's—the highest class—having been built under special survey. The carrying capacity is 1,600 tons, and she will be propelled by a pair of Messrs. Palmer's inverted direct-acting compound surface condensing engines of 100-horse power nominal. The engines are being erected under the superintendence of Mr. Ward. As the Zoe glided down the ways the ceremony of christening her was gracefully performed by Mrs. Cocquerel, of London, wife of one of the co-owners.

Lambeth.—On the 2nd was launched from the yard of Palmer's Shipbuilding and Iron Company (Limited), Jarrow, a screw steamer called the Lambeth. This is the third vessel of the same description built for the same owners at the same place. As is well enough known, great expense is incurred in transshipping coal below the London Bridge, and sending it to the upper part of the Thames. Up to about a couple of years ago, however, there seemed to be no other means of transport than the ordinary barges; but about that time a way out of the difficulty was perceived by Messrs. Nicholls & Co., of London, and several shipbuilders were communicated with by them with a view to carrying the idea to a practical issue. The Lambeth is 220 ft. long, 32 ft. broad, and 15 feet deep, whilst she carries 1,000 tons of coal on a draught of 12 ft. of water. She has a peculiar arrangement forward, technically called a "Turtle back," for throwing off the water from her stem, and she has also a double bottom for water ballast throughout. She is fitted with Hastil's (of Greenock) patent steam-steering gear, and her engines are of 99-horse power nominal. The construction of the hull and engines are being superintended by Mr. A. Nicholls, one of the owners of the vessel. The christening ceremony was performed by Miss Pawson, of Jarrow.

Beatrice.—On the 2nd inst. Messrs. Turnbull & Son launched from Whitehall Shipyard, Whitby, a new screw steamship of the following dimensions:—Length 240 ft., breadth 34 ft., depth 17 ft. 9 in., deadweight capacity 1,950 tons on a light draught of water. The vessel, which has been built under special survey to class 100 A 1 at Lloyd's, will be fitted with engines of 130-horse power by T. Richardson & Sons, Hartlepool, and is owned by the builders and their partners. On leaving the ways she was named the Beatrice by Miss Debenham.

Hartville.—On the 3rd inst., Messrs. Wm. Gray and Co., of West Hartlepool, launched an iron screw steamer, which has been built to the order of Messrs. Groves, Maclean and Co., of West Hartlepool. Her dimensions are:—Length between perpendiculars 256 feet 6 inches; breadth, 34 feet 6 inches; depth of holds, 19 feet 9 inches and 24 feet 3 inches; and her gross tonnage is about 1,760, her carrying capacity being 2,350 tons of cargo. She will be classed 100 A 1 at Lloyd's, having been built throughout under the special survey of Captain Barnes. Her engines, 150-horse power, are by Messrs. T. Richardson and Sons, of the Middleton Ironworks, Hartlepool. As she left the ways she was christened the *Hartville* by Miss Clara Maclean.

Calvilla.—On the 3rd inst. Messrs. Joseph L. Thompson and Sons launched from their yard, North Sands, an iron screw steamer, built to the order of Messrs. Thomas E. Hick and Co., of Scarborough. This vessel has been constructed under special survey to class 100 A at Lloyd's, and will be fitted with the most modern improvements for the rapid loading and discharging of the cargo, &c. The engines, which are of 130-horse power nominal, on the compound surface condensing principle, are being supplied by Mr. John Dickinson, of Palmer's hill Engine Works. The ceremony of naming the vessel the Calvilla was gracefully performed by Miss Kish, of Sunderland. The Calvilla is intended for the Mediterranean and Baltic trades, and will be under the command of Captain J. H. Major.

Tug Boat.—On the 4th was launched from the building-yard of Messrs. Softley and Sons, South Shields, a new iron tug steamer of the following dimensions:—Length, 85 feet; breadth 18 feet; depth 9 feet 6 in. The engines of 40-horse power will be fitted by Messrs. T. R. Scott and Co., North Shields. The steamer has been built to the order of Tyne owners.

George.—On the 6th inst. there was launched from the yard of Messrs. Woodhaye & Johnson, North Shields, a large new tug steamer, intended for Constantinople and the Dardanelles. Her owner, Mr. C. Compothega, of Constantinople, was present, together with Messrs. Hepple, Laing, Cockburn Brothers, Astarita, Captain Pano, Mr. Vanaschiotti, &c. The steamer was named the George, and will be classed eight years at Lloyd's. She will be engined by Messrs. Hepple & Co. This is the sixth boat that Messrs. Hepple have built for the East this year.

On the 6th there was launched from the yard of Messrs. Osborne, Graham & Co., of North Hylton, near Sunderland, a screw steam hopper, which has been built for the Indian Government, and intended for service at Kurrachee Harbour. Her dimensions are:—130 ft. by 28 ft. by 10½ ft., carrying 400 tons of *débris*, and her engines will be supplied by Messrs. Hawks, Crawshay & Sons, of Gateshead-on-Tyne, and are 50 nominal horse power. She has eight powerful ratchet winches for raising well doors, and is otherwise equipped in the most complete manner. The builders are building a sister vessel for the Indian Government, which will be launched shortly.

Phœnix.—The Phœnix, 6, composite sloop, was launched at Devonport Dockyard on September 16th. She is a sister ship to the Dragon and Pegasus, launched from the same yard in May and June of last year, and to the Miranda, which is being constructed in the adjoining dock, and is to be launched at the end of the present month. They are all built upon the same moulds, with the exception that the Phœnix and Miranda will be fitted with raised poops, giving them better fighting qualities, and increasing accommodation for officers. The Phœnix has a frame of iron with wood planking, and is constructed to carry a ram. She will have a fore and aft fire. Her length is 170 ft. between perpendiculars, extreme breadth 36 ft., and depth of hold 16 ft. 9 in. Her displacement when she is completed for sea will be 1,124 tons; her actual weight when launched was 565 tons. Messrs. Humphrey, Tennant & Co., have supplied her engines, which are of 900-horse power, and she is expected to realise a speed of 13 knots. The ceremony of christening the Phœnix was performed by Mrs. Farquhar, wife of the Commander-in-Chief.

Success.—On the 16th September a wood screw lighter, provisionally named the Success, was launched from the slipway adjoining the Commercial Dry Dock, Rotherhithe, by Messrs. Briggs & Co. This craft will carry about 120 tons on light draught of water, being 65 ft. long, 17 ft. beam, and 7 ft. hold. The engines proposed to be placed in her are about 25-horse power. It is intended not only to carry cargo, but will have sufficient engine power to take two or three laden barges in tow.

Plantyn.—On September 17, Messrs. Alexander Stephen and Sons launched an iron screw steamer of about 2,350 tons, of 100 A 1 Class in Lloyds, and also of highest class in Bureau Veritas, and fitted with compound surface condensing engines of 220 horse power nominal. The vessel was named Plantyn by Mrs. Dunn, of Garnethill. The Plantyn is constructed with a double bottom on the bracket principle throughout the entire length of the vessel. In accordance with the usual practice at this yard, the machinery was fitted on board complete and ready for sea before the vessel was launched. The time occupied from the date of laying the keel up to the day of the launch was no more than four months and nine days. The Plantyn is the third steamer built by the Messrs. Stephen for Messrs. T. C. Engels and Co., of Antwerp, and is to take her place in the White Cross Line between Antwerp and New York, a trade for which she has been specially designed. She is fitted with superior accommodation for a limited number of passengers.

Norman.—On September 17 there was launched from the building-yard of Messrs. C. Mitchell and Co., a screw steamer, which on leaving the ways was named the Norman, by Mrs. Clapham, wife of the managing owner. She is in all respects a sister vessel to the Ethel, built a little while ago by Messrs. Mitchell for the same owners. The ship has a carrying capacity of 1,300 tons, and her draught of water, with weight to this extent, will only be 14 feet 10 inches. The point of special interest in the matter is that the whole of the steel employed in the construction is of local manufacture, having been made by the Weardale Company, Tudhoe. Immediately after the launch the vessel was towed to the Wallsend Slipway and Engineering Company's Works, where she will be fitted by them with compound engines, having all the latest improvements for economy and efficient working.

Mabel.—On September 17 Messrs. W. Gray and Co. launched from their yard at West Hartlepool a screw steamer, built to the order of Messrs. Coverdale, Todd, and Co., of West Hartlepool. The dimensions are :—Length between perpendiculars, 228 feet; breadth, 30 feet; and depth of hold, 16 feet 9 inches, and 20 feet 9 inches; and her gross tonnage is 1,120 tons. She will carry 1,400 tons of cargo and bunkers on a light draught; classed 100 A 1 at Lloyd's; engines 100-horse power, by Messrs. T. Richardson and Sons, of Middleton Ironworks, Hartlepool. As she left the ways the vessel was christened the Mabel, by and after Miss Mabel Rawlings, eldest daughter of Dr. Rawlings, J.P., of Hartlepool.

Tug Boat.—On the 18th September there was launched from the building-yard of Messrs. Softley and Sons, South Shields, a tug boat, of the following dimensions :—Length, 50 feet; breadth, 10 feet; and depth, 6 feet. This vessel has been built to the order of Messrs. Pile and Co., of Great St. Helen's, London.

Iowa.—On the 18th September the Iowa was launched from the building-yard of Messrs. R. and J. Evans and Co., Brunswick Dock, Liverpool. She is a screw-steamer which has been constructed to the order of Messrs. G. Warren and Co. The Iowa is of about 4,300 tons gross register, and has throughout been designed and built under the superintendence of G. S. Goodwin, Esq. Messrs. James Jack and Co. will supply the machinery.

Hong Ann.—On Sept. 22nd there was launched from Messrs. Wigham, Richardson, and Co.'s Neptune Works, Low Walker, a very finely-modelled screw steamer for passenger and coasting trades at Singapore. As the steamer left her berth she was gracefully christened the Hong Ann, by Miss Jessie Victoria Mackenzie, daughter of Captain Mackenzie, under whose superintendence the Hong Ann has been built.

Gunboat.—During the past three years the Admiralty have been constructing rapidly one after another a very useful class of gunboat of from six to 10-gun calibre. Several of these vessels have already proved their worth, and on September 16th another was added to the list by the launch of the Phœnix, at Devonport. Her keel was laid in July of last year. She is 170 feet long, 36 feet beam, and 1,124 tons displacement. Messrs. Humphreys have fitted on board engines whose indicated power are to be 1,000 horses. She will be best known when she is described as belonging to the Amethyst class, carrying six guns and composite built. The only difference in her and the former vessels is that she is built of steel, and covered with wood, and has a raised poop—the latter an advantage that needs no comment. The Miranda, a vessel of an exactly similar build, but engined by Messrs. Napier, lies on an adjoining building slip, and will be launched in a fortnight. The ceremony of christening was performed by Mrs. Farquhar, wife of the Admiral commanding the port, and was quite successful. The whole of the arrangements were satisfactorily carried out under the direction of Rear-Admiral C. W. Hope, Admiral-Superintendent of the yard.

SCOTCH.

Britannia.—On the 21st August another addition was made to Messrs. Henderson Brothers' fleet of steamers by the launch of a vessel of 3,000 tons from Messrs. D. and W. Henderson's yard at Kelvin. The steamer was named Britannia, after one of the early Clyde and New York traders which were the foundation of the "Anchor Line." This vessel is intended for the line between Glasgow, Liverpool, and Bombay.

Excelsior.—On the 21st a sailing barge, named Excelsior, was launched from the shipbuilding yard of Mr. John Taylor, Crown Quay, built to the order of Mr. George Green & Co., of Stow Maries, Maldon, Essex, for the forage trade. Miss Florence Pillow, of Milton, christened the vessel in the usual way.

Queen Mary.—A fore-and-aft rigged steam yacht was launched from the building yard of Messrs. Alexander Hall & Co., on the 30th ult. Her dimensions were as follows :—Length, 128 ft.; breadth, 22 ft.; and depth 11 ft. She is 169 tons gross register, is fitted with engines of 50-horse power, steam windlass, winch, and all the latest improvements. As the yacht left the ways she was named the Queen Mary by Miss Hall. The vessel has been built to the order of Mr. John G. Mackie, Auchencairn, Castle Douglas Kirkcudbrightshire.

Sunflower.—On the 13th Sept., the Sunflower, an iron double-ended paddle-steamer, was launched from the shipbuilding yard of Messrs. T. B. Seath, at Rutherglen, on the Clyde. She is built to the order of the Wallasey Local Board, and is intended for horse and goods traffic on the Mersey, between Liverpool and Seacombe. Her dimensions are 140 by 26 by 10 feet; tonnage, 448 tons. Her machinery, which is by D. Rowan, Glasgow, consists of a pair of surface-condensing diagonal oscillating engines, cylinders 30 inches diameter and 60 inches stroke, two tubular boilers, feathering wheels, &c.

William of Riga.—On the 16th Sept. an iron steam vessel, built to the order of a Russian firm, was launched by the Campbeltown Shipbuilding Company. Her dimensions are as follows :—Length, 168 feet; between perpendiculars, 180 feet; breadth, 27 feet 6 inches; depth of hold, 13 feet; deadweight capacity about 825 tons; horse-power, nominal, 80. The vessel is to be engined by Messrs. Kincaid, Donald, and Co., Clyde Foundry, Greenock.

Mendoza.—On the 17th September Messrs. R. Napier and Sons launched from their shipbuilding yard at Glasgow a steel steamship, built for the Pacific Steam Navigation Company. Her dimensions are :—Length 320 feet; breadth, 40 feet; depth, 21 feet 8 inches; gross tonnage, 2,240; with compound engines of 2,000 horse-power indicated. This ship, which is of a peculiar type, to suit the service on the West Coast of South America, is built of Siemens steel, made by the Steel Company of Scotland. In adopting this high-class material, the Pacific Company have followed the example of the British Admiralty. A sister ship for the same service was launched from Messrs. Napier's yard about a month ago. On leaving the ways the vessel was christened the Mendoza by Miss Rodger, daughter of Mr. W. Rodger, of Oaklands, Cheshire.

Montreal.—On the 18th September Messrs. Charles Connel and Co. launched at Scotstoun the Montreal, an iron screw-steamer of 3,280 tons gross, the first of two they are building to the order of Messrs. Flinn, Main, and Montgomery, Liverpool, for the Mississippi and Dominion Steamship Company (Limited). The sister ship, which is to be named Toronto, is in a forward state. These vessels are built with several extras beyond the highest class at Lloyd's for three-decked steamers, and are fitted with all the latest improvements for the cattle trade, special attention having been paid to the ventilation and water supply. The vessel was towed to Finnieston crane for her machinery, which is being supplied by Messrs. John and James Thomson, Finnieston Engine Works. The keel of the Montreal was laid early in May, and she has thus been only about 4½ months on the stocks.

Australian.—There was launched during the month from the shipbuilding yard of Messrs. Gourlay Brothers & Co. a screw steamship of the following dimensions :—Length between perpendiculars, 160 feet; beam, 22 ft. 6 in.; depth of hold, 10 ft. 6 in.; and of 360 tons gross tonnage. As the vessel left the ways she was named Australian, and has been built to the order of Messrs. G. & B. Nicoll, of Sydney, N.S.W., for their coasting trade. She has been specially surveyed and built to Lloyd's Board of Trade requirements, is fitted with water ballast, steam winches, and steam-revolving crane; has every necessary modern appliance and convenience.

six water-tight bulk-heads; has a luxurious saloon amidships for the accommodation of 32 passengers, bath-room, lavatories, &c., and accommodation for 20 second-class passengers aft; and altogether has a very high-class finish. The engines and boiler are of the most modern type for economy of fuel, &c., and represent about 70 H.P. nominal, and from which a good rate of speed is expected. She leaves under steam about a fortnight hence for Sydney, touching at Plymouth, Cape of Good Hope, and Adelaide. The Australian is the third steamship built by Messrs. Gourlay for Messrs. G. & B. Nicoll.

TRIAL TRIPS.

The Mangerton.—This screw steamer, built by Messrs. Andrew Leslie & Co. of Hebburn to the order of Mr. John D. Milburn, of Newcastle, for the Atlantic and Eastern trades, had a trial on the 26th August. The vessel is 285 ft. long, 25 ft. beam, and 24½ ft. depth of hold, and has a deadweight capacity of 3,000 tons. Her engines have cylinders 32 and 62 in. diameter, 42 in. stroke, and a working pressure of 10 lbs. On the trial at the measured mile the engines indicated 884-horse power, and gave a speed of vessel running north 10·909 knots, and running south 11·533 knots, or a mean speed of 11·22 knots. On the completion of the trial the steamer departed on her voyage to Baltimore, in charge of Captain James Hogg.

Bristol City.—On the 30th August, the new steamer Bristol City made her official trip in Hartlepool Bay. The ship has been built by Messrs. Richardson, Duck & Co., of Stockton-on-Tees, to the order of Messrs. Charles Hill & Sons, Bristol. Her principal dimensions are:—Length, 260 ft.; breadth, 34 ft. 6 in.; mean draught of water, 20 ft. 6 in. Her engines have been constructed by Messrs. Thomas Richardson & Sons, Hartlepool Engine Works, being the 636th pair of engines fitted to steamers by this firm. The parties all embarked, and the ship proceeded to the south, the average speed attained being about 12½ knots per hour.

Ebro.—On the 4th September the iron screw steamer Ebro, lately built by Mr. Laing for Messrs. D. G. Pinkney & Son, of Sunderland, had a very successful trial trip. The Ebro left the port early in the morning to adjust compasses. A pretty stiff S.W. breeze was blowing, and the vessel steamed southwards a little below the mouth of the Tees and back, attaining a speed of 10¾ knots per hour, which was highly satisfactory. The Ebro will carry about 1,500 tons, all told, on a mean draught of about 15 feet. The engines were supplied by Mr. George Clark.

Malabar.—The Indian troopship Malabar, Captain Grant, made a two hours' full power trial on September 4th, at the back of the Isle of Wight, after extensive repairs and readjustments of her machinery, including the raising of her screw shaft. The trial was very successful, a mean speed of 12½ knots being realised with 49 revolutions per minute. The horse-power indicated was 2,526.

Orontes.—The Orontes troopship, Captain Kinahan, made a trial of her machinery on September 5th, after having undergone a general overhaul. Chief Engineer Tuck represented the Steam Reserve. Everything worked satisfactorily. The pressure in the boilers was 60½ lb., the vacuum in the condensers 25·68 in., the revolutions per minute 65, and the total indicated horse-power 2,243. A mean speed of 12·5 knots was obtained.

Laurium.—On the 16th September the screw steamer Laurium, which was launched by Messrs. Schlesinger, Davis, & Co., iron shipbuilders, Wallsend, four or five weeks ago, had a satisfactory trial trip. The Laurium is a spar-decked iron screw steamer, and her leading measurements are:—Length between perpendiculars, 253 ft.; breadth moulded, 33 ft.; and 23½ ft. depth of hold. She classes 100 A 1 at Lloyd's, under special survey. The Laurium left the builder's yard about noon, and steamed out to sea, where a trial of speed was made at the measured mile off Whitley. The engines have been put on board by Messrs. R. and W. Hawthorn, Newcastle, and are of 150-horse power, high and low pressure surface-condensing, and have been constructed under the superintendence of Mr. Mead, engineer, of Cardiff. The engines worked without the slightest hitch during the day, and the steam-steering gear (Harrison's patent) also gave great satisfaction. The Laurium returned to the Tyne to load for Havre, under the command of Captain Dessaux.

Leo.—The iron screw steamer Leo, built by Messrs. C. S. Swan & Co., Wallsend, for Mr. R. B. Avery, Newcastle, left the Tyne on the 20th September, with a full cargo of coals on board, bound for Genoa. After adjusting compasses the vessel was run along the coast, and gave the most satisfactory results. She is of the following dimensions:—Length between perpendiculars, 285 ft. breadth, moulded, 35 ft.; and 24½ ft. depth of hold. The engines have been put on board by Mr. George Clark, Sunderland, are of 200-horse power, and embrace all the latest improvements.

Bavington.—On Saturday afternoon, September 20th, the steamship Bavington, belonging to Messrs. Hine Bros., of Maryport, proceeded into the river for a trial trip, after undergoing repairs and being fitted by Messrs. Cochrane & Co., of Birkenhead, with one of their patent multitubular vertical boilers. This trial was of interest, as the steamer is the first of the small coasting class that has been fitted with one of these boilers. The boiler which it replaced was an ordinary return tube double furnace boiler, and was quite unable to keep up steam. The new boiler kept steam to the working pressure of 50 lb. per square inch easily, and afforded an abundant supply. Capt. Wilkinson, overlooker, and Messrs. W. R. McKaig, and J. Carlton Stitt, superintendent engineers on behalf of the owners, were present at the trial, and expressed themselves highly satisfied with the result. Immediately after the trial the steamer sailed for Duddon.

One of the 80-ton guns tried at the proof butts in the Government Marshes at Woolwich last week, with satisfactory results, was taken down to Shoeburyness in the gun barge Magog, and will be landed in the situation most suitable for a trial of its accelerated powers by a series of rounds fired over the Maplin Sands. It is confidently asserted that the enlargement of the bore and powder chamber will effect a considerable increase of range, which is of importance as proving an augmentation of battering force, but not of much practical value, seeing that the gun has already attained a range of over ten miles. The trial is more especially for the purpose of testing the gun's accuracy and fixing the sights. The removal of the gun has been rather sudden, and it is not yet determined whether or not it is to be removed to the land platform at Shoeburyness and fired at the iron targets. The relative merits of British and foreign ordnance—a subject which has recently attracted much attention—is officially illustrated by the following comparisons laid before the War Office as the results of experiments made last year, the guns fired being of about equal weights. The Krupp long 30·5 centimetre (German) breechloader, weighing 38 tons, firing a battering shell of 725 lb. with a powder charge of 158·7 lb., registered a muzzle velocity of 1,645 ft. per second, equivalent to a total energy of 13,604 tons. The Woolwich 38-ton muzzle-loading gun, with an 810 lb. shell and 200 lb. of powder, registered 1,560 ft. velocity, or 13,668 tons. In the comparison of these two guns the difference in their bores has to be considered, the English weapon having a calibre of 12·5 in. and a length of 198 in., while the German gun is 12·01 in. only in the bore, which is 264·6 in. long. The lesser weight of the Krupp shot consequently brings it to the front in calculating the energy per inch of shot circumference, which is the true figure of penetrative powers, the record being 360 for the German and 350 for the English gun. This difference, small in comparison with the disparity of length, has since been reversed, and the energy for each inch of the shot's circumference is now about five tons in favour of the British gun. The Elswick (Armstrong), 40-ton breechloader, of 12-in. bore, takes third place. With a length of bore practically the same as that of the Krupp gun (264 in.) it fired a shell of 700 lb. with a charge of 190 lb. of powder, and realized a velocity of 1,637 ft., or an energy of 13,007 tons, being 345 tons per inch. The French 38-ton breechloader, which has a bore of 12·6 in. calibre, and is 243 ft. long in the bore, fired only 139 lb. of powder with its 770 lb. shot, and registered 1,371 ft., which represents 10,036 tons of energy, or 253 tons per inch; while the corresponding gun of the Italians, by increasing the cartridge to 150 lb., raised the velocity to 1,411 feet per second, and the energy to 10,630 tons, or 268 tons to the inch. The Russian great gun corresponds in weight and calibre with that of Sir William Armstrong's, being a 12 in. breechloader of 40 tons, but it has only been tried with a powder charge of 120 lb. and a 650 lb. projectile. The small diameter has given it a velocity of 1,398 ft. per second, but the energy works out at only 8,808 tons, or 234 tons per inch. These figures give some of the chief grounds upon which the national gun-makers of England base their belief in the superiority of their system, and their contention that in the manufacture of still larger guns the results will be still more in their favour. The relative cost of the rival great guns is an important factor in the gunnery problem, and it is as follows:—The Krupp steel gun of 70 tons, £22,000; the Armstrong 100-ton coiled wrought-iron gun, £16,000; the Woolwich (Fraser) wrought-iron coil gun, 80 tons, £10,000. Therefore, two 80-ton guns of the Woolwich type can be constructed for the cost of one of their German rivals and leave £2,000 to the good.

Correspondence.

[It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience. ED.]

To the Editor of the MARINE ENGINEER.

SIR,—While the Engineers in Her Majesty's Service would be very glad to know that they have a champion on shore who could properly ventilate their grievances in a practical manner by means of your valuable Journal, still those "who know" will fail to see the good that will result from the letter in your number of Sept. 1st last.

The writer of that letter, although signing himself "An Engineer of Her Majesty's Service," displays entire ignorance of the Queen's Regulations, in fact, the whole tenor of the letter smacks more of "land" than "sea breezes." I should doubt whether he knows where to find the Engineers' Mess Berth on board a Man-o'-War, consequently he is not likely to know much about the grievances of the engineers.

What is wanted is a champion who can write from experience, if an engineer, so as to be able to relate facts, without fear of incurring the displeasure of the Lords Commissioners, who have had the importance of engineering science in the navy forced upon them in these days of iron-clads.

I hope to see the subject well brought out in your Journal.

ONE WHO HAS SERVED.

DEAR SIR,—I read with great interest in your September number the account you gave of the vessels being built by Messrs. Denny & Co., of Dumbarton, which certainly speaks highly for their enterprise and success as shipbuilders.

As regards the longitudinal, or deep floor system, and bracket frames, I quite concur with you that they are a great improvement. As regards the former (deep floor) I believe that I can rightly claim the idea as my own and that I was the first to bring it out, and though Messrs. Denny have been the first to obtain the reduction as regards the tonnage dues, that was one of the principal points that I had in view, and the reduction would have been obtained, I believe, sooner had not an alteration been made in my arrangement. In 1874-5 my serious attention was first drawn to the longitudinal weakness of the bottoms of iron steamers, especially in way of the boiler space of what are termed three-decked vessels, caused principally by the water ballast tanks being stopped between the engine and boiler bulkheads; as regards the after portion of this space, the engine seating, being constructed in the form of longitudinal boxes well secured to the floors, was sufficient to make up for the loss of the tank girders and top plating, but as the boilers are usually supported upon cradle-bearers, running athwartships, the vessel had only her ordinary keelsons to depend upon. And taking also into consideration that the total weight of the engines, boilers, and bunker fuel contained between the boiler and engine bulkheads, is only about one half of the displacement of that portion of the vessel when immersed to the load water line, there was a weakness in way of the boiler space through stopping the water ballast tanks and also a great upward pressure (which would increase as the bunker fuel diminished) caused by the extra weight of cargo placed in the fore and after holds.

It also struck me that it was seemingly unfair for the shipowner to be compelled to pay tonnage dues for a space which could never be used for carrying cargo in.

My plan was completed in April, 1875, and was as follows:—

To carry the ordinary tank girders and centre keelson, which usually run on top of the floors, down to the skin plating, continuing them fore and aft continuously on their lower edges, they would have angles rivetted to the shell between the ordinary frame angles and on their top edges angles rivetted to the tank top as usual. The frame angles to be continued as at present from keel to gunwale being scored through the lower edges of the longitudinals, the ordinary floors to be dispensed with, and in their place deep intercostal plates to be fitted on—say every third frame about 6 ft. apart, fitted between the longitudinals and rivetted to the shell plating and to the tank top.

The girders are carried through the boiler space and worked into the engine seating, though it is not compulsory to have the tanks continued. This arrangement, with a modification as to the placing of the deep intercostal plates, was carried out in a vessel built by Messrs. S. P. Austin & Hunter of Sunderland (with whom I was engaged from 1874-76) for the Lambton Company, and launched in the summer of 1876, and I understand several other steamers have since been constructed on my system by that firm. At the annual meeting of Naval Architects in 1877, Mr. Martel, of Lloyds, read a paper upon the various descriptions of water ballast tanks, and described my system as recently carried out by Messrs. Austin & Hunter.

Since then it has gradually gained favour, and I believe several firms are likely to take the idea up.

Trusting that you will excuse my taking up so much of your valuable space, and that you will kindly allow me at a future time to further explain my ideas on this interesting subject of longitudinal strength.

M. W. AISBITT,
Naval Architect and Marine Surveyor.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from August 22nd to September 18th, 1879.

Supplied by the City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

Grain-elevating Machinery. W. R. Lake (communication, J. B. Stoner). 3389.
Apparatus for checking steel wire hawsers and cables. W. M. Bullivant. 3390.
Ships' lamps, T. Blake. 3399.
Apparatus for producing parallel and divergent pencils of light for signalling, lighthouses, illumination of distant objects, &c., G. Pitt. 3425.
Imparting increased motive power to machinery, D. Quare. 3433.
Steam engines, H. L. Müller (communication, A. Mestern). 3434.
Deep sea-fishing or trawling apparatus, J. W. de Caux. 3438.
Furnaces and fuel feeders, E. Bennis. 3443.
Automatic valve for boats in place of plug, J. Casey. 3450.
Steam supply regulator, J. D. Churchill. 3457.
Telegraph wire insulating material, A. Wilkinson. 3472.
Deep sea-sounding apparatus, T. F. Walker. 3487.
Apparatus for harbour protection, J. Shields. 3490.
Cement for steam-tight joints, F. G. Olliver. 3502.
Elevating and transporting apparatus for grain, salt, small coal, &c. W. Poulsom. 3506.
Prevention of excessive pressure of slide valves upon faces, A. A. W. van Reede. 3514.
Furnaces of steam-boilers, J. W. Lord. 3563.
Fish ways and passage of boats, A. M. Clarke (communication, M. McDonald). 3566.
Mechanism for loading and unloading fuel, &c., in cubical or other blocks, F. Service. 3589.
Net hauling machine, J. H. Fitzgerald. 3595.
Ships' berth always horizontal, L. A. Groth (communication, T. O. L. Schrader). 3603.
Propulsion of vessels, D. H. Sisson. 3623.
Steam engines, surface condensers, and valves, W. Turnbull. 3625.
Ships' logs, A. M. Clarke (communication, A. Gordon). 3629.
Slide valves, J. N. Holliday. 3631.
Composition for coating ships' bottoms, W. Ward. 3650.
Buoys and mooring apparatus for same, G. C. Lenox. 3657.
Governor valves, J. Tangye. 3674.
Steam or pressure gauges, G. Salter. 3676.
Fuel supply and smoke consumer, N. Macbeth and T. Beeley. 3687.
Protecting and preserving composition for ships' bottoms and submerged surfaces, G. S. F. Edwards. 3690.
Driving and removing piles, G. R. Glover (communication, J. Seehehay). 3698.
Surface condenser for engines and distilling apparatus, E. Wimshurst. 3705.
Screw Propellers, Herbert John Haddon (communication, E. A. Heath). 3709.
Automatic Expansion Gear, H. Simon (communication, J. Schmidt). 3723.
Compressed fuel, M. Blair. 3725.
Boilers and plates for boilers, shipbuilding, &c., J. Whitley. 3742.

Review.

The Sailor's Sea-Book, with Mathematical and Nautical Tables. Published by Messrs. Crosby, Lockwood & Sons.

THIS is a combination of three works from Weale's Rudimentary Series, the first of which, by James Greenwood, and revised by W. H. Rosser, is a treatise on navigation, which we have already reviewed as most concise and intelligibly simple in our last issue. In the combined work now before us there is added to the above treatise a series of mathematical tables for trigonometrical, astronomical, and nautical calculations, by J. R. Young, to which is prefixed a treatise on logarithms by Henry Law. Following these there is still a third treatise by J. R. Young, of tables to facilitate calculations in navigation and nautical astronomy. These tables are intended to be used conjointly with the mathematical tables in the preceding part, to facilitate the working out of the problems explained in the first part. These latter tables are briefly the sines and cosines to every quarter point of the compass; the natural sines and cosines; difference of latitude and departure, or traverse table for points and for degrees; proportional logarithms; tables to determine distances and mean time, and so on. It will be seen that the above three treatises combined form a complete sea-book, both the latter parts being necessary to the first part in working out the problems given therein. The whole book is well and clearly printed, which is a great point in tables of figures, it is handy and portable, and should be just the thing for either yachtsmen who are desirous to navigate their own vessels, or for practical sea-goers.

Notes and Novelties.

GREAT progress continues to be made in the construction of the new armour-plated torpedo ram at Chatham Dockyard, as the Admiralty are desirous to have her completed as soon as possible.

THE Spit, or bell, buoy, which marks the head of the Spit Shoal in the Solent, and acts as a guide to ships entering Portsmouth Harbour, has been much improved by Mr. J. Shervill, of Buckland, who was formerly connected with the Dockyard. Hitherto the great difficulty has been to cause the bell to ring at times of dead calm, and to prolong the vibration. When the buoy was first placed in position a bell of the ordinary pattern was fitted upon it, having two fixed hammers or clappers on the outside. When the bell, therefore, was made to oscillate by the wind or the swell of the water, it was brought into contact with the hammers and gave the alarm. There were, however, two objections to this principle. It took considerable motion to make the bell act, and when the blow was struck the hammer remained in contact and deadened the sound. As a result in quiet, foggy weather, when its services were most required the bell ceased to ring, while at other times the sound was so low and short that it could only be heard at close quarters. About six years ago Mr. Shervill took the matter in hand with the consent of the naval authorities, and effected a great improvement. He substituted a gong for the bell, and instead of delivering the blow by means of a hammer he made use of brass balls running along radial ways. Each of the four ways contained three grooves. Set in motion by the movement of the water the ball ran down the centre groove and struck the gong, and was then immediately thrown into one of the lateral grooves by its own impact. This arrangement was found to prolong the sound, but it was necessary for the ball to make a circuit of the leads before striking, it did not remove the former objection of being only operative in comparatively rough weather. As it was lately determined to remove the buoy for repairs, Mr. Shervill was asked to fit it with a new invention, which he has applied with satisfactory results to the Calshot buoy, in Southampton Water. In the improved system, which is a modification of the old, each of the four radial ways contains only one groove, and is thus of much simpler construction. Each way is about 2 ft. long, a little incline at the bell end, up which it runs to strike, serving to bring it back immediately after striking, and allow the vibrations to continue. A similar check at the other end shortens the run of the balls in calm weather, and enables them to act against the gong with the slightest movements of the sea. A new method of supporting the gong upon a spindle also tends to strengthen the sound. The apparatus was inspected by Admiral Fanshawe on September 1st, and secured to its moorings on September 4th. Mr. Shervill's principle will now be generally adopted.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Thomson, J. ...	2 C	Lvrpool.
Worthington, J.	2 C	do.
Jardine, T. J. ...	2 C	do.
Holden, R. W.	1 C	do.
Davies, J. E. ...	2 C	Bristol.
Carter, Thomas	2 C	do.
Taylor, Wm. ...	2 C	Grenock.
Grant, John ...	2 C	do.
Campbell, F. ...	2 C	do.
Duncanson, F. ...	2 C	do.
M'Quade, Peter	2 C	Lvrpool.
Scott, John ...	2 C	do.
Ross, Thomas ...	1 C	do.
Price, Edward J.	1 C	do.
Foster, William...	2 C	N.Shlds.
Baggaley, Robert	2 C	do.
Wright, Ernst N.	2 C	do.
Riddle, James ...	2 C	do.
Christie, Wm. ...	2 C	do.
Prest, Matthw.A.	2 C	do.
Hayes, Michael...	1 C	do.
Webster, John...	1 C	do.
Minto, William	1 C	do.
Ochiltree, Robert	1 C	do.
Thompson, Chas.	1 C	do.
Ollett, Charles ...	1 C	do.
Smith, William...	2 C	Lvrpool.
Orr, Thomas ...	2 C	do.
Troughear, J. H.	2 C	do.
M'Gowan, James	2 C	do.
Templeton, John	1 C	do.
Graham, John ...	1 C	do.
Stewart, Alex. ...	1 C	do.
Brolly, Arch. B.	2 C	Glasgow.
Campbell, Geo...	2 C	do.
Johnson, Wm....	2 C	London.
Livingston, D. ...	2 C	Hull.
Edgar, Henry F.	1 C	do.
Meyer, Wm. C.	1 C	do.
Humble, Henry	1 C	do.
Watson, Jno. W.	2 C	Lvrpool.
Robertson, Robt.	2 C	do.
Martin, William	2 C	do.
Tabret, Henry C.	1 C	do.
Stephens, David	2 C	N.Shlds.
Dalgliesh, John	2 C	do.
Wood, Joseph ...	2 C	do.
Reid, John ...	2 C	do.
Eyre, Harry ...	2 C	London.
Farrell, Henry ...	2 C	do.
Moss, Henry ...	2 C	do.
Ryan, John Hy.	1 C	do.
Bond, James ...	1 C	do.
Twigden, Francis	1 C	do.
M'Callum, D. ...	1 C	Grenock.
Aitken, Hugh ...	1 C	do.
Small, Hugh C.	1 C	do.
Hendry, Duncan	1 C	do.
Barclay, William	1 C	Grenock
Struthers, A. ...	2 C	do.
M'Kenzie, John	2 C	do.
Muir, Robert ...	1 C	do.
Miller, Quintin...	1 C	do.
M'Gechan, Robt.	1 C	do.
Stirling, John ...	1 C	do.
Taylor, John ...	1 C	do.
Urquhart, F. ...	1 C	do.
Griffiths, Jno. A.	1 C	Sthmtn.
Drewry, Thomas	2 C	Hull.
Marshall, J. R....	1 C	N.Shlds
Sheppard, G. A.	2 C	London.
Whittle, William	1 C	do.
Wilson, John ...	2 C	Sndrlnd.
Mitchell, J. G. ...	2 C	do.
Heckells, R. A.	2 C	do.
Wright, William	2 C	do.
Halliday, James	2 C	do.
Willey, Robert...	1 C	do.
Johnson, George	1 C	do.
Kirkup, Thomas	1 C	do.
Phillips, Wm. P.	2 C	London.
Woodhead, John	2 C	do.
M'Pherson, D. ...	2 C	do.
Huntley, Thomas	2 C	do.
Orr, James W. ...	2 C	Glasgow.
Gordon, David ...	2 C	do.
Cree, Isaac ...	2 C	do.
Steel, John ...	1 C	do.
Watt, James ...	1 C	do.
Bain, William ...	1 C	do.
Anderson, Jas. ...	2 C	London.
Jobson, Gibson...	1 C	Sthmtn.
Rate, George S.	2 C	Bristol.
Stafford, John ...	2 C	N.Shlds.
Richardson, J. J.	2 C	do.
Stewart, Robert	2 C	do.
Smith, Wm. Hy.	1 C	do.
Chambers, Wm.	1 C	do.
Muir, David G....	2 C	Leith.
Nicholson, R. D.	2 C	do.
Mudie, Robert...	2 C	do.
Stewart, Thomas	1 C	do.
Davies, David ...	2 C	Bristol.
Nettell, Wm. H.	2 C	do.
Whitburn, H. L.	2 C	do.
Buckham, Joseph	2 C	Lvrpool.
Parting, William	2 C	do.
Sergent, Wm. J.	1 C	do.
Davidson, Geo....	1 C	do.
Birch, James E.	2 C	Cork.
Taylor, William	2 C	Dundee.
Campsie, Peter ...	2 C	do.
Fowler, Alex. ...	2 C	Aberdn.
Gray, Alex. ...	2 C	do.
Albarn, John ...	1 C	Hull.
Thompson, F. ...	2 C	do.

ROBERT JACKSON, Registrar-General.

General Register and Record Office of Shipping and Seamen
32, Basinghall Street.

Messrs. R. Napier & Sons, shipbuilders, Glasgow, have obtained an order from Government to construct a single screw vessel for the War Department to carry stores. She will be 160 ft. in length, 24 ft. breadth, and 12 ft. 9½ in. in depth; 450 tons, and her plating will be of steel.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

ADVERTISEMENTS must be sent in not later than the 23rd of each month to ensure insertion in the following number, addressed to W. G. Neal, 3, Amen Corner, Paternoster Row, London, E.C.

NOTICE TO THE TRADE.

THE "Marine Engineer" is now published by Grattan Marshall & Co., 3, Amen Corner, Paternoster Row, London, E.C. to whom all orders should be sent and P.O.O'S. &c., made payable. Yearly Subscriptions, 5s.

The Marine Engineer.
LONDON, NOVEMBER 1, 1879.

EDITORIAL NOTES.

THE North-East passage has at last been successfully traversed by Professor Nordenskjöld. From time immemorial our maritime history has been full of interesting and gallant attempts to reach the North Pole by what was termed the North-West Passage. It has, perhaps, been forgotten that the original object in the discovery of a North-West Passage was to find the shortest route from England to the far West in preference to the voyage round Cape Horn. It is, however, a curious fact that can be ascertained from the investigation on a terrestrial globe, that the shortest route from England to China and Japan is almost due north from England, that is rather to the Asiatic side of the pole than to the American side. Any possible North-Eastern route along the northern shores of Asia has never, however, met with much investigation from our Arctic explorers, and thus Professor Nordenskjöld's successful voyage strikes us with all the force of novelty. It is, perhaps, questionable whether the route thus opened could ever prove of any commercial value as a communication between England and China, although it may be in actual distance the shortest route. The Professor has been rather more than a year in effecting his passage, but this excessive delay was occasioned at a point little anticipated. He started from Gothenburg on July 4th, 1878, and doubled the Cape Chelynsky, which is accounted the most difficult part of the route, so successfully that the vessel might reasonably have passed Behring's Straits before the end of September, 1878. However, a delay of two days was sufficient to ice-bind the vessel in lat 67 deg. 7 min. N., and long. 173·24 W., for the whole winter, so that she did not arrive at Behring's Straits until July 20th, 1879. The Professor reports that, with a greater knowledge of times and seasons in those seas, the passage might be practicably used as a communication between Northern Europe and Asia, that is, China, Japan, and British Columbia. We fear, however, that the shortness of the season open to traffic, and the very liability, though only accidental and occasional, of being ice-bound twelve months after date would prevent any possible commercial communication that way. If it were in any way possible for such communication to be successfully used, it would, no doubt, be a great incentive to maritime interest in Norway and Sweden, which would thus find themselves on the direct route to China and Japan. We scarcely think the route will do more than serve to open up some further trade with Northern Siberia, as it seems there is a navigable river which communicates from that coast with the interior.

THE sham fight at Portsmouth, representing a naval night attack on one of our dockyards, is a subject of great interest to our naval forces. The efficiency of defensive torpedoes is a subject about which little has really been known, and also the value and practicability of offensive operations by "counter-mines," and "creeping," has been open to much discussion. We give details of the battle elsewhere in this issue, and the results seem to have been in favour of the Royal Engineers and their defensive operations. The application of the electric light to defensive operations has, no doubt, made all the difference to successful defence. The destruction of any material obstruction in a channel, such as a boom seems to be easily effected by the attachment and explosion of a dynamite charge. An opening of 100 feet in width was easily effected by a single charge in the operations referred to, through a boom ten inches square. And the clearing of a further channel through torpedoes by means of counter-mines seems to have been easy of operation, if only time and opportunity are given to the attacking vessels to effect this. If the whole operations had been conducted in the darkness without illumination for the benefit of the defenders, there seems little doubt to us that the attacking party would have been successful. As it was, however, the electric light was freely used to brightly illumine the principal scene of conflict at the boom and in the disputed channels, so that the attacking flotilla and the gunboats or ironclads were exposed clearly to whatever defensive fire could be brought to bear on them from the heavy guns and field pieces on shore. The result altogether depended on this, for first the attacking flotilla were disabled or sunk by the musketry and artillery fire at the boom, and after the boom had been successfully broken, two attacking vessels were disabled by either the artillery fire or an observation mine, and though the third vessel, the *Vesuvius*, succeeded in dropping a line of counter mines and exploding them, the space cleared was not considered sufficient for an ironclad, and it was evidently only a question of time as to how soon even she would have been disabled. We are surprised to see that no apparent effort was made by the attacking force to first disable the electric light before proceeding to the attack. No doubt this could not be done if thought of, as it would have entirely destroyed the excellence of the spectacle. In any case the inference remains very clearly, as we think that so long as a defending force can employ an electric light, the attack had better be made by daylight, as the attacking force is supposed to be strange to the locality, and cannot direct an effective and distracting fire upon the defences. If the electric light could have been destroyed by the attacking force it seems to us that the attack could have been successfully carried out in the darkness.

Some little curiosity has been excited by rumours of a strange new ironclad that is about to be built for the Czar by Messrs. John Elder & Co., on the Clyde. The rumour has, however, now received its detailed explanation in the fact that the vessel is to be an experimental yacht, built to carry a floating palace for the Czar. It is, however, worthy of our attention to remember that, whatever substructure may be most stable for carying a floating palace will also prove most suitable for a steady gun platform in a rough sea, and that a deck-palace may easily be removed and a gun battery substituted in its place. The design of the yacht in question is to some extent a modification of the Popoff ironclad, but is so distinct in its character as to be an entire experiment *sui generis*. The shape of the substructure of the yacht may be best represented to the mind as similar to a gigantic turbot, with an extreme length of 230 feet, a maximum breadth of 153 feet, and a maximum depth at the centre of 18 feet. The greatest draught of the hull is only 6 feet, but a depression at the rear is made to give a depth of 16 feet immersion for the screws, which are three in number. This part of the vessel may be lifted considerably by flooding the fore compartments of the vessel. The turbot hull is to be divided into a large number of air-tight compartments so as to be practically unsinkable. It is to be built entirely of Siemens steel, and to contain apparently only the engines, boilers, and coal bunkers. The engines are to be the lightest for their power in the world, and are to be built in three distinct sets, one to each propellor. The speed obtained is to be 14 knots an hour. It is evident that a new system of flotation is here to be tried, viz., a shape which will tend to rise on and float on the surface of the water rather than to force its way through the water, as in our present system of hulls. The experiment will be interesting, and have our closest attention.

It is somewhat a matter of wonder to us that marine engineers have not yet accomplished a rough and ready means by which any breakage or accident to the main propeller shaft may be readily repaired at sea, so as to act sufficiently well to bring the vessel to port. As our principal mail steamers and ironclads are all dependent, particularly in bad weather, upon their engines and propellers any sudden fracture of the shaft may at once consign such a steamer to an untimely end on a lea shore. We note that the fine Peninsular and Oriental Company's steamship the *Australia* broke her main shaft off the Start a few days ago, and was thus left helpless until the Government tugs the *Valorous* and *Trusty* had been despatched to take her in tow. We think that every steamer should carry clamps or clamp couplings, which might be readily bolted and keyed to the propellor shaft at any part on each side of a possible fracture. A shaft should also be so laid in a vessel that it was readily accessible anywhere in its length for such a hasty repair as above indicated; when such clamp couplings had been securely attached to the two portions of the shaft on each side of the fracture they could be well connected for driving purposes by even cables or chains through perforations in the couplings. Or spring steel bars, made on purpose to form the connections between such couplings, might be carried by each vessel ready for such an emergency. The probability of the shaft breaking outside in an inaccessible point in the water or in the bearings might be almost removed by care in making such parts of the shaft stronger than more accessible portions.

The late encounters of the South American, that is to say, Peruvian ironclad Huascar, have been of great value in pointing out what a light, swift steel corvette is capable of doing. Although considerably inferior to many of the Chilian fleet in number of armament and defensive powers, her high speed has rendered it almost impossible to catch her, and she has thus with impunity long harassed the Chilian marine, and made for herself a dreaded name along that coast. In the former times of naval combats between sailing vessels, the possession of the "weather gage" was well understood to confer a considerable advantage upon the vessel securing it. In these days of steam there is no such thing as the "weather gage," but we think that the question of relative speed has taken its place in naval combats of the present day. The power to close or retire at will must confer an immense advantage, and it is easily conceivable that a swift, lightly armoured vessel may prove much more destructive than a heavier weighted vessel to an enemy's merchant shipping. At the same time such a vessel would still be able, if armed with one or more very long range guns, to give a good account of herself, even in conflict with a much more heavily armoured ironclad. A shell is as destructive at a long range as at a short one, and the power conferred by greater speed of being able to choose the exact distance most suited to herself must give a great advantage to such a vessel. We think that the long contended battle between heavy guns and heavy armour may with advantage give place to the consideration of how best to attain maximum speed.

STEAM GENERATION.

Robert Walker's Patent Hydro-Carbon Furnace and Apparatus.

THE generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough ; science has endeavoured to cope with the difficulties, but with little practical results hitherto. In a patent, taken out by Mr. Robert Walker, C.E., F.R.G.S., of 19, Buckingham Street, Strand (from the reports placed before us of the actual working of the invention), we appear to have arrived at the *ne plus ultra* of perfection in the production of steam, especially for steamships, as the steam is generated with great rapidity and economy, and without smoke, sparks, or dirt, while the fires can be lighted up or extinguished instantaneously. Mr. Walker's Patent Hydro-Carbon Furnace and Apparatus covers an arrangement by which common air is rapidly converted into hydro-carbon gas of great heating power, which is stored in a receiver, subjected to pressure, and thereby forced out through a pipe to the burners from which combustion takes place (underneath, but between the fire bars) in the furnace. Upon these bars is fixed a layer of incombustible lumps of minerals made up as a coal fire would be, but having this great difference, viz., that, being indestructible by fire, it remains intact. When the hydro-carbon gas is lighted the flames rise in vivid combustion through the firing, and the furnace soon gets heated, and the air within becomes hot and rarefied. Then a series of tuyeres are started and inject with air or steam, or both, crude hydro-carbon in the form of fine spray into the already hot furnace. The force of the air-blast rises the hydro-carbon spray some distance into the furnace, and discharges it, finely pulverised and mixed up with air, as impregnated hydro-carbon vapour, over the red-hot firing and blazing gas, and complete and effective combustion is insured, and the flame passes along the flues as in the case of an ordinary fire, but without producing either smoke or sparks. Additional air may be admitted with the hydro-carbon spray if required, through the air apertures (in the tuyeres), which may be opened or closed by a sliding outside collar, and which is adjustable by a lever arm. The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation in the practical working of the invention, and the apparatus can be added to the existing furnaces of steam ships, without any alteration of the engines or boilers.

The combination of burning hydro-carbon gas with heavy oils, which forms the principal fuel that Mr. Walker proposes to use, would also be thus readily put under the control of the captain or other responsible officer. A valuable point to be noticed in such a Hydro-Carbon Furnace is the command which can be in the hands of a single individual, to at once extinguish, or light up, or diminish, or increase the fire. There is also great cleanliness about such a system. No smoke, we suppose, and no cinder or ash to get rid of, and little or no soot.

If we analyse the effect produced by this mode of combustion, we shall find that the heavy oils, projected in the form of minute globules into the already hot furnace, present a great surface to the oxydising effect of the air which surrounds them, and which has been their vehicle; therefore they get inflamed instantaneously throughout the mass. The residue of this combustion which takes place in this finely divided state being so minute ($\frac{9}{1000}$ part of each original globule), they are consequently totally carried away by the draught, at the same time the globules or fine spray, being on all sides enveloped in air, perfect combustion is attained, and consequently no smoke. The comparison of the profit from the saving in storage and economy in the results gained will best be made from the following data, viz., Say one ton of coals measures 48 cubic feet, then one ton of hydro-carbon only measures 17·50 cubic feet, the saving in storage is therefore 30·50 cubic feet per ton in favour of the hydro-carbon fuel, and if we take the calorific power of coa per pound as estimated at 8,000 caloric units, then that of liquid hydro-carbon per pound must be taken at 18,000, which gives an advantage weight for weight of 62½ per cent. in heating power to liquid hydro-carbon as compared with coal; but then, in the combustion of coal, as carried out in the construction of our boilers and fire-grates, only a very small proportion of the heat theoretically developed can be made use of, whereas by Mr. Walker's patent, by burning hydro-carbon gas and crude or heaty lubricating oils in a gaseous form, as we have before mentioned, the comparison of useful caloric effect obtained from coal and hydro-carbon has been made, viz., that in the pound of coal only 50 per cent. caloric effect is utilized, or 4,000 caloric units, (which is probably much over rather than under the mark), and in the use of the hydro-carbon 100 per cent (as nearly as possible), or 18,000 caloric units, is claimed to be utilised. The comparison, then, that one pound of liquid hydro-carbon is equal in evaporating power to 450 pounds of coals seems fully justified. These advantages in favour of hydro-carbon fuel, as burned by Mr. Walker's patent, are immense, and must eventually effect a complete revolution in our present mode of steam generation. For steam ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessice quantity of coal which they require, and the excessive price which, in those distant seas, they are obliged to pay for it. Take, for example, one of the Royal Mail Companies Steamers plying between Southampton and Central America. For the outward voyage she requires to take on board at Southampton 800 tons of steam coal costing say £700, and for the return voyage a further 600 tons at Jamaica costing, say £1,300 total, 1,300 tons costing, say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent, in lieu of coals, would require 200 tons, to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons, and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo, it would be worth, to the Royal Mail Company, £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c. would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage.

For use in the Navy it would be equally important. In time of war our largest ironclads, as now constructed, would never be able to cross the ocean without being surrounded by a fleet of colliers to supply them with coal. The *Devastation*, although built as a sea-going monitor, intended to cross the *Atlantic* in time of war, can only store coal on board for a cruise at full speed of from twelve to fourteen days. She might store sufficient Hydro-carbon fuel, with Mr. Walker's patent, to steam from sixty to seventy days at full speed.

A further very large field for the successful use of this Hydro-carbon fuel will be in metallurgical operations, such as the reduction of metals, and particularly in the case of iron smelting. The chemical purity of the gases of combustion, and the enormous degree of heat which can rapidly be attained, estimated at 5,000 degrees, and the absence of all deleterious matter, such as sulphur and phosphorus, must prove most valuable in producing the purest and most perfect qualities of iron and steel, &c. We understand Mr. Walker is at present arranging terms for the royalties for the working of his patent, and we expect soon to report further progress of this most valuable invention, from the results gained by those ocean-going steamers by which the patent may first be worked.

Since we received this article (which, owing to a press of matter, we were unable to insert in our last number), the following has appeared in the *Times* of the 25th ult., which fully confirms the opinion we have expressed of the vast importance of this invention to steam-ship owners and passengers:—[Ed.]

"Petroleum as Fuel.—A method of using petroleum as fuel for steam boilers has been recently tried at Pittsburgh (U.S.) with, it is said, complete success. The steamer *Billy Collins* was slected for the test, and was fired up at 9 a.m. A preliminary blaze of wood under the boiler raised a small quantity of steam necessary to start the burner into operation. The needle of the steam-gauge climbed rapidly up the dial, and in twenty minutes the safety-valve blew off at 120 lb. pressure. It was a remarkable sight. Here was a boat puffing through the water with no sign of smoke from her chimney, no speck of soot in flue or fire-box, no fireman, no opening of furnace doors, no dirt, no coal going in, no clinkers or ashes to be seen anywhere. A turn of the hand regulated the terrible flame that seemed to be trying to overpower the limits of the furnace, and another turn of the hand brought the fire down to a quiet little flame, a foot or two long. . . . The labour and expense of 'firing up' are dispensed with, and the engineer can regulate the flame as he does the steam in his engines. The danger from sparks and flying cinders is entirely done away with. . . . Farther, the wear and tear upon boiler, grate, bars, &c., is infinitely less, and it seems scarcely necessary to add, the comfort of passengers is greatly enhanced by the absolute freedom from dirt of all kinds. To ocean-going steamers this device must prove of extraordinary interest."

BOILER EXPLOSION ON BOARD THE TUG-BOAT "VICTOR."

A BOARD of Trade inquiry has lately been held at Belfast, into the circumstances attending the explosion of a boiler on board the tug-boat Victor, this explosion having caused the death of one of the stokers, named Conlon. The inquiry was held before Mr. C. D. Clifford-Lloyd, sitting as judge, with Captain Holt, I.N., and Mr. R. C. May as assessors.

The Court has now been engaged for a week upon this inquiry, and though the facts of the case are simple in themselves, it has been necessary to examine many witnesses at considerable length, in order to find out whether blame attaches to any person on account of the bursting of one of the boilers of the steam-tug Victor, and if so, to whom. The inquiry has been somewhat protracted on account of the complete absence of documentary evidence which might have existed, and indeed should have existed, in such a case. The facts are simply these:—The Victor is a paddle wheel steam-tug, built of wood at Middlesbrough-on-Tees, in September, 1863; her official number is 47,052; gross tonnage, 79.41 tons, but after deducting the engine and boiler room, 22.02 tons; sloop rigged, carrying one mast. At the time of the accident she was fitted with jet-condensing engines of 40 horse-power (nominal), and to supply them with steam there were two double-flued boilers, each firing at both furnaces. These engines and boilers were made by Reynoldson, of South Shields. Her port of registry is Bridgewater, and she is held in 64 shares by three owners in nearly equal portions, named respectively Henry Quinn, Hugh M'Dowell Pollock, and Alexander Mitchell, all of Belfast. On the register Henry Quinn appeared as the managing owner, but it was stated in evidence by Henry Quinn that this was an error, and that Hugh M'Dowell Pollock was and is the managing owner, and upon the latter gentleman making the application to the Court he was admitted as such to be a party to the proceedings under Rule 7 of the "Shipping Casualties Rules, 1878," and appeared throughout in person. The present owners purchased the ship in the year 1876, from a steam-towing company of and at Bridgewater. The Victor left one of the Belfast quays at about 6.30 a.m. on Sunday, August 10, 1879, having in tow a Norwegian barque. The Victor had on board on that occasion a crew of four hands, viz., a master, an engineer, a fireman, and one deck hand for the helm, the latter being an able seaman. The master on this occasion was one Hugh M'Greevy, who acted as such upon Sundays, and upon other days as mate, the master being Henry Quinn (before referred to as one of the owners); who, however, was exempted from Sunday work by agreement with his co-partners. None of the officers belonging to the ship held certificates. All appears to have gone well until about 8.30 a.m., and at this time the Victor, with the Norwegian barque in tow, was about midway between Carrickfergus and Greypoint, the pressure of steam, as indicated by the gauge, being about 18 lb. to the square inch, much below the pressure at which the lock-up safety valve would blow off. At this time a slight explosion was heard by some one on board, steam was seen issuing from the engine hatch, and immediately afterwards from one of the coal bunker filling holes, and the fireman Francis Conlon was seen trying to gain the deck by that aperture from his place in the stokehole, he being badly scalded by the steam and boiling water that was found to be issuing from the starboard boiler. Assistance being rendered he was extricated and found to be severely scalded; so he was removed to the Royal Hospital, where he died the same afternoon. The origin of the explosion was then ascertained. A portion of the floor-plate of the midship furnace of the starboard boiler had given way close to a joint in the plates, and immediately under the firebrick bridge that supported the inner ends of the firebars, and from this rent the steam and hot water issued that scalded and caused the death of the fireman Conlon. The engine driver appears to have acted most promptly and properly, he backed his engines, cast off the barque in tow, eased off his safety valves, threw off the expansion gear, thus doing all he could from the deck (his position when the engines were at work) to reduce the pressure of steam. When the pressure of steam was so far reduced as to enable the engine-room to be entered, and the boilers examined, the latter were temporarily repaired, and the Victor returned to Belfast, where she was at once again examined by Mr. Sowter, one of the surveyors to the Board of Trade in this port. Mr. Sowter sent in a report to the Board of Trade, and the ship was by authority detained. Mr. Sowter subsequently sent in a more detailed report. Both of these reports had been handed in, and made evidence, which in effect was, that the damaged plate was at the injured part extensively corroded upon the under side, and within an area of three or four square inches was reduced in thickness to about $\frac{1}{16}$ in., at which part it gave way under a pressure of steam below what the boilers were considered capable of safely working at. Such being the facts of the case, it remains to consider the evidence bearing upon the various questions submitted to the Court by the Board of Trade, and to give a decision upon them *seriatim.* Question 1. What was the cause of the explosion or casualty on board the Victor, on August 10th, 1877, whereby the loss of one life ensued? There is the clearest evidence on this subject; viz., that of the engineer of the vessel, and of Mr. Sowter, the Board of Trade surveyor. The Court finds the cause to have been the impossibility of a portion of the floor plate of the midship furnace of the starboard boiler withstanding the ordinary working pressure of the boilers, owing to its being eaten away by corrosion, resulting from the ordinary working of the boilers. Question 2. Whether the vessel had at any time since her construction been supplied with new boilers? The evidence of William Gregg shows that at the time of purchase in 1876 the boilers were the original ones, and as they have not been renewed since, the Court has no hesitation in finding the vessel had not been supplied with new boilers since her construction. In an inquiry of this nature, where the age of the boilers

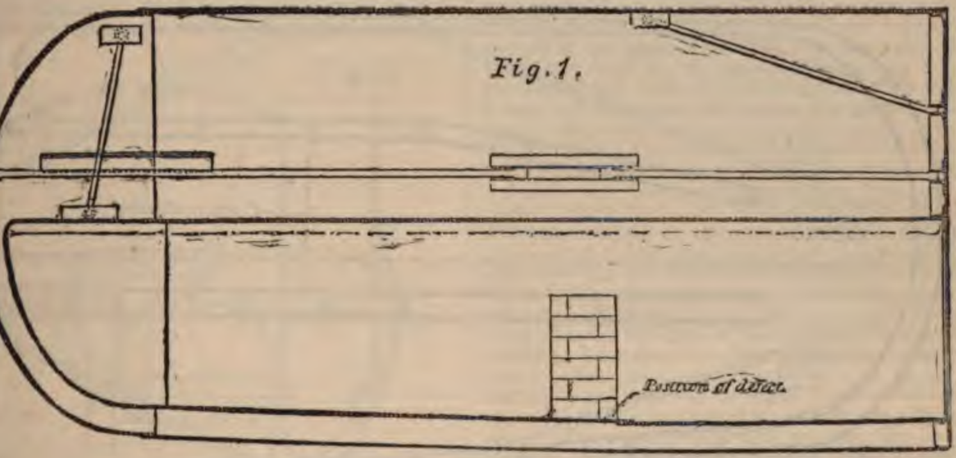


Fig. 1.

[illegible] under consideration, the Board of Trade should [illegible] satisfactory evidence before the Court bearing upon [illegible]. The only evidence there is touching upon the age of [illegible] at the time of purchase by the present owners in 1876 [illegible] the man William Gregg, who was called at the suggestion of the Court. Mr. Pollock could give no evidence as to their age beyond the fact that since he had been part owner no new boilers had been put into the vessel. When Mr. Pollock bought her in 1876 he did so upon the recommendation of this William Gregg, given through a Mr. Andrews, and he (Mr. Pollock) then believed the boilers to be three years of age (they being in reality thirteen years old). Founding this belief upon the statement of some individual, whose name he does not even remember, Mr. Pollock did not even inquire the age of the boilers from this William Gregg, who had made an examination (such as it was) of them. The Court cannot conceive more reckless negligence than for the purchaser of a steamer to put men to work in a stokehole without having had the boilers examined by a qualified person, thereby risking an explosion and consequent loss of human life. From Mr. Pollock's own evidence, he knew so little about the boilers of this vessel that even the age of them was unknown to him or to any of his co-partners. William Gregg neither made a proper examination nor was he apparently qualified to do so. He did not remove the bridges, and had he done so he would have discovered that underneath the two other furnaces corrosions, which had been patched, had taken place similar to that which was the cause of the explosion which is the subject matter of this inquiry. He states he knew the age of the boilers at the time he examined them, but did not communicate this all-important information to the intending purchaser, as he was not asked. As a consequence William Gregg either purposely concealed it from, or signally failed in his duty in not communicating it to them, as he had been sent over specially to examine and report upon the engines and boilers. The intending purchasers, however, should have known what sort of man they were employing upon this most important duty; and if people, either from motives of economy or otherwise, will employ such an incompetent person as William Gregg has proved himself to be in this particular respect, the responsibility attaching to them is all the heavier. This witness states that he knew that the parts under the bridges were specially liable to decay, yet he did not examine them by removing the bridge; he knew the age of the boilers; he knew that the price of a vessel of the Victor's size materially depended on the age of the boilers; and yet he swears that he did not communicate what he knew to the intending purchasers who had employed him. The witness further states that corrosion might have been going on without his seeing it, and nevertheless he reported the boilers sound. As Mr. Pollock said, in addressing the Court, the evidence of this witness is, indeed, unsatisfactory. Notwithstanding its being so, and although it was opposed to common sense and even to probability in fact—coupled with Mr. Pollock's evidence that the age of the boilers was not given—the Court can only accept it as true, condemn, in the interest of others than the owners, a purchase made in such a manner, and attach the responsibility to the proper person or persons. Question 3. Whether the owners of the vessel took reasonable and proper precaution to ascertain and to satisfy themselves that the vessel and her machinery, particularly the boilers, were in good and seaworthy condition? Many of the remarks made above apply equally in considering this question. The Court concludes that the question refers to the time when the accident occurred. However the owners may have acted as regards the hull and engines, they never from the moment of purchase caused a thorough examination of the boilers to be made. They at first endeavoured to show that in placing the vessel at times in the hands of Messrs. MacIlwaine and Lewis for repairs to the boilers there was an implied authority to make this thorough examination; but Mr. Mitchell's evidence and that of Mr. J. Lewis quite does away with this contention. No thorough examination could have been made without removing the brickwork bridges in the flues, and Mr. Mitchell states that he never gave any such orders to Messrs. MacIlwaine and Lewis, and would have been much surprised had the firm done so without such orders. Mr. Lewis, the foreman of Messrs. MacIlwaine and Lewis, states that Mr. Mitchell, having a knowledge of boilers and engines, always gave specific instructions as to repairs in the execution of which, if Mr. Lewis discovered any other defects, authority was always given to make them good also. There is a vast and very important difference between this and handing over a vessel to a firm for the purpose of having a thorough examination made of the boilers and all defects reported to the owners. The owners not having had this examination made when purchasing the vessel, and not having had it made since, up to the time of the accident—an examination which, if made, would have disclosed the plates in such a state that precautions would have been taken, and repairs made, which would have prevented the accident under consideration, and consequently loss of human life—the Court must hold that such reasonable and proper precautions as are alluded to in the question were not taken by the owners of the tug Victor. Question 4. Whether the owners were justified in placing the vessel under the charge of uncertificated officers, either in the management of the vessel or in the care of the machinery? It is the custom, there is no law against it, and therefore the Court finds that the owners were justified in so doing, the responsibility of course attaching to themselves for so doing. Question 5. Whether Messrs. MacIlwaine and Lewis, who repaired the boilers, did properly examine and repair the boilers in June last, and whether they were justified in neglecting to test them by the usual means

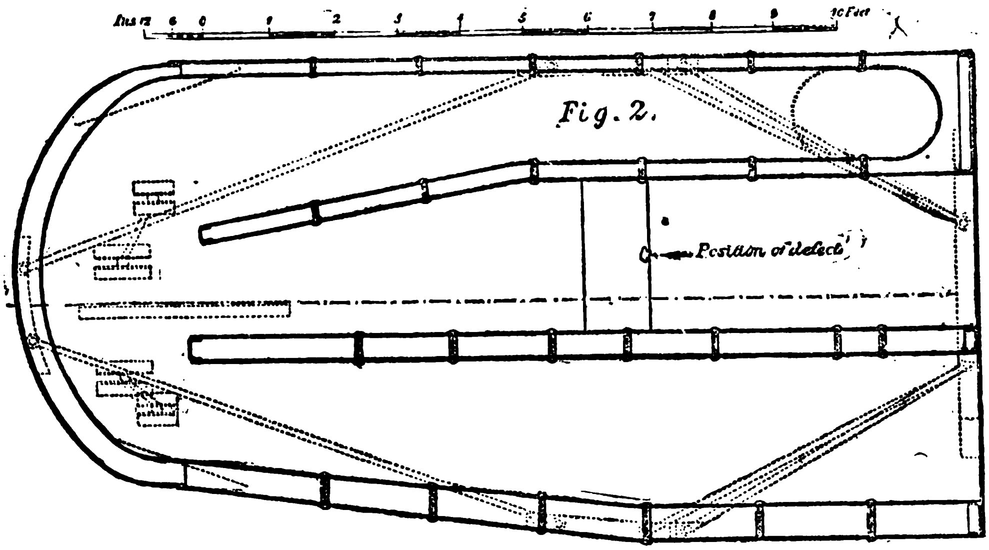
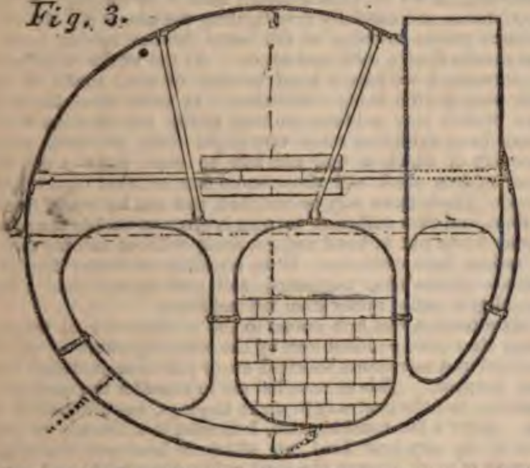


Fig. 2.

after such repairs? At the sitting of the Court on Saturday, September 13th, Messrs. MacIlwaine and Lewis, represented by Mr. MacIlwaine, appeared before the Court and complained that such a question should be put to the Court without their having been made a party to the case by the Board of Trade. The Court understands that owing to some misapprehension on the part of the Board of Trade, Mr. Joseph Lewis, jun., Messrs. MacIlwaine and Lewis's salaried foreman, was made a party to the case, instead of Messrs. MacIlwaine and Lewis themselves. The Court would certainly not have answered this question in a manner condemnatory to the Messrs. MacIlwaine and Lewis themselves without having given the firm an opportunity of becoming a party to the proceedings, and pleading its cause, but as it exonerates the firm from all blame in the matter, the Court has no hesitation in stating so, and in finding accordingly. The evidence of Mr. Mitchell, a part owner, who stated he was practically acquainted with and much experienced in this class of machinery, and of Mr. Lewis, jun., as reviewed above, clearly shows that Messrs. MacIlwaine and Lewis were not called upon to make any such examination of the boilers as is indicated in the question, and there is no evidence before the Court to show that such usual tests as are applied after repairs such as Messrs. MacIlwaine and Lewis made in June last were not applied or were neglected. Question 6. Whether Messrs. MacIlwaine and Lewis are justified in asserting that the boilers were in June last in good order to work safely for twelve months at a pressure of 25 lb. to the square inch, having regard to the fact that they had not in any way been tested by them, that some parts were out of sight, and could only have their state ascertained by other means than those of sight, and that some plates of the boilers were known to be badly corroded, and were reduced from $\frac{3}{8}$ in. to $\frac{1}{16}$ in. in thickness? Mr. MacIlwaine, on the part of his firm, also respectfully protested to the Court upon Saturday against such a question being put to the Court without their ever having been made a party to the proceeding. The Court has no evidence whatever before it that Messrs. MacIlwaine and Lewis ever did so assert. This erroneous assumption on the part of the Board of Trade seems to be grounded upon the evidence given by Messrs. MacIlwaine and Lewis's foreman—Mr. J. Lewis, jun., a salaried servant to the firm. It is true that this witness made a statement to the effect that, after examining the boilers in June last, such was his opinion as to their capabilities, but he informed the Court that there should have been a thorough examination of the boilers (which, not having been ordered by the owners, was not made) to make that opinion of any value. It is not shown in evidence that even he (the foreman to Messrs. MacIlwaine and Lewis) so much as verbally expressed this opinion to the owners of the vessel. So the Court quite fails to see how the expression of an opinion by the servant of Messrs. MacIlwaine and Lewis, upon September 4, 1879, and admitted by the person who offered it to be valueless, ought to be the groundwork of an assumption seriously reflecting upon this firm, or how it is sought thereby to make this firm in any way contributory to a casualty which occurred on August 10. The Court, therefore, finds that Messrs. MacIlwaine and Lewis did not make any such assertion as contained in the question. Question 7. Whether a properly-qualified person was appointed by the owners to take charge of the machinery, and whether the person acting as such took proper means to ascertain that the engines and boilers of the vessel were in good and proper order? Question 8. Whether the cleansing of the boilers and the prevention of corrosion were properly looked after by the master? The man in charge of the machinery and the master were of the ordinary class met with in boats of this description and the Court thinks, there being no law upon the subject, that the owners, subject to the responsibility attaching to themselves thereby, were justified in placing them in their respective positions, which they filled apparently to the best of their capabilities. The officers of the ship examined the boilers frequently where they could be seen, the examination of the other parts could only take place by temporarily laying the vessel up, which could only be done by order of the owners. Question 9. Whether, when the vessel left Belfast, she was in good and seaworthy condition, and if not, who are the parties responsible for the vessel having left that port in a bad and unseaworthy condition? The Court is of opinion that the Victor was not in a good and seaworthy condition when she left Belfast (her moorings) on the 10th of August last—that is, so far as her boilers are concerned—and they consider the owners are responsible for her having been in and having left her moorings in this unsound condition. Question 10. Whether she was properly navigated, and whether her boilers were worked at too great a pressure? The Court finds that she was properly navigated, and that, supposing the boilers to have been sound, they were not worked at too great a pressure. Question 11. Whether everything was done for the deceased fireman by those on board, by extricating him from the stokehole, attending to his wounds and scalds, and conveying him ashore and placing him under medical care? The Court finds that everything was so done. Question 12. Finally, whether the master, the owners, the Messrs. MacIlwaine and Lewis, or any other person or persons, or either of them, is in default? The Court is of opinion, and finds, that the owners—namely, Hugh McDowell Pollock, Henry Quinn, and Alexander Mitchell—are individually and collectively in default in this matter. They are to blame, inasmuch as they purchased that vessel originally upon the recommendation simply of an incompetent person. So far as his opinion upon such a matter went, they took no proper means of ascertaining the real condition of the vessel's boilers in all parts, either at the time of purchase or since, up to the date of accident. Since the date of the purchase up to that of the accident they have left everything connected with the repair of the vessel's machinery and boilers in the hands of one of themselves, Mr. Alexander Mitchell, who directed himself what repairs were to be undertaken. The responsibility thus put upon him by the owners, and accepted by him with that confidence which a little knowledge too often gives, was out of all proportion to his capacity and responsibility, which would otherwise have probably rested with a firm of engineers capable of undertaking it. The result was that a particular part of a boiler specially liable to decay was never subject to an examination during the present ownership, and the particular part corroded away, and finally burst, causing a loss of human life. The Court on these grounds holds the owners in default, and orders that they pay the costs of this investigation. The Court remarks how much more satisfactory it would have been to all parties directly or indirectly concerned, and how much easier it would have been to point out where responsibility rested, had the reports on which the vessel was purchased, the order for repairs, and the opinions asked for and given (if any) been in writing. The Court takes this opportunity to gladly acknowledge the valuable assistance it has received throughout this investigation from Captain Holt, late Indian navy nautical assessor, and from Mr. R. C. May, engineer assessor. To the latter, indeed, the Court is specially indebted for all the technical knowledge and experience willingly placed at its disposal, and is glad to say that both these gentlemen concur in this judgment.

Fig. 3.



Patch referred to in evidence was about this point, say 2 ft. long fore and aft, and 1 ft. round circumference. Bridge was about 1 ft. fore and aft, and patch coincided with front of bridge.

Position of defect which caused explosion. This defect was the result of pitting of the plate, and was of an irregular shape, roughly speaking 4 or 5 in., 2 or $2\frac{1}{2}$ in.

The Handelsblad is informed that a third steamship for service between Flushing and Queensborough is to be built by Messrs. John Elder and Co., of Glasgow, for the Steam Navigation Company, Zeeland. It must be ready by next Spring, and will be christened the *Queen Emma*, after the second consort of the King of Holland.

At Hull.—Earle's Shipbuilding and Engineering Company have secured contracts for the construction of three large steamers

THE MANUFACTURE OF LARGE FORGINGS AND THE MATERIALS SUITABLE FOR THE SAME.

PAPER READ BEFORE THE IRON AND STEEL INSTITUTE AT LIVERPOOL BY G. RATLIFFE, MERSEY STEEL AND IRON WORKS, LIVERPOOL.

THE subject of the manufacture of forgings, and the materials suitable for that purpose, opens up a very wide question, respecting which there must naturally exist great diversity of opinion. In the paper I am about to to read to you I purpose confining myself to laying before you the results of a few actual experiments made within the limited time at my disposal since I was induced to bring the subject before you at this meeting, avoiding as far as possible pressing upon you the conclusions to which I have been led.

Of late a great deal has been said about building vessels of steel instead of iron, and for the safe use of the former superior material certain rules have been laid down. At the last meeting of this Institute (in London) a valuable paper on the use of steel for shipbuilding was read, which led to a most interesting discussion as to the various uses, applications, and behaviour of steel, and of steel and iron combined. Cases, were referred to in which vessels made of steel (and in using the word steel I wish it to be understood that reference is made to cast and not puddled metal) had, upon examination shown satisfactory results as to wear, &c., except in some instances, in which iron (by iron is meant puddled metal) had been used in connection with the steel; as, for example, where iron rivets had been used the steel plates were pitted to a considerable extent round about, and a similar effect was noticed near the keels and stern-frames, &c. Such remarks were looked upon by members in different ways, the general impression seeming to be that by punching the holes and hammering the rivets, a certain quantity of scale was disturbed, and that this allowed oxidation to take place more rapidly. This, without doubt, might assist the pitting. At the Mersey Steel and Iron Company's Works, however, we have eighteen Cornish boilers made of Snedshill plate, with the exception of three plates in the flues, which are made of steel. The flue-plates are all jointed together by flanging, and in all cases we have found the steel plates have pitted more than the iron, and the plate next to the iron has oxidised considerably more than any other. A piece of this plate lies on the table. I have had it analysed by Mr. Edward Riley, of London, and the result is as follows :

Carbon	·330
Silicium	·102
Sulphur	·065
Phosphorus	·066
Iron	99·320
Manganese	·518
Copper	·053
	100,454

The fact is, that although many of these boilers have done comparatively little work, owing to dull trade, nearly all of them have had to be patched on the flange adjoining the iron, so that a reasonable conclusion is, that if we are to build our vessels of steel we must endeavour to use steel throughout, and that now a suitable quality of this material is produced for rivets, keels, stern-frames, &c., we may look forward to seeing all parts of the vessel made of it.

Mr. Adamson, in his paper read at the Paris meeting, laid before us some very valuable tests both of iron and steel, and it is now my desire to draw your attention to the practical tests made by myself with a view to elucidate the subject of this paper.

It is universally admitted that the part about a marine engine which requires the most constant care and renewal is the crankshaft, though lately attention has been called to a greater proportion of straight shafts failing than was usual in years past. This may, no doubt, be attributed in some cases to inferior materials, and in others to the extra amount of work transmitted through the shafting.

As to the welding of metals together, it may suffice to say that long before my recollection, or that of any gentleman in this room, hard cast steel has been welded to iron for such purposes as the manufacture of hammers, axes, swords, table-knives, &c., and it must, therefore, be admitted as practicable to weld all descriptions of iron and steel scrap. It has also been generally understood that the best iron forgings are made from welding together the best selected scrap iron—a theory, I may say, which has been held for a period beyond the recollection of any of us present. At the time this theory was first introduced no doubt it was correct; but for some years past I have seen reason to change my opinion on that point. In olden times we had good iron of fairly uniform quality; but now we have iron of very many qualities, and, for the most part, inferior. If twenty men were set to select a quantity of iron all of uniform quality, no two of them would perfectly agree; aud if the metal first piled together was not of a uniform quality, no hammering, rolling, or working whatever put upon it could make it so.

The greatest quantity of scrap that finds its way into forges is the ship-yard scrap, and that certainly cannot be the best, as it is produced from the cheapest iron that is manufactured. Or take old iron rails, and no one will say that the iron rails made of late years have been made of the best iron. Do not let me here be misunderstood. Although the iron in many cases used for rails was good for that purpose, it could not be so for general forgings; rails requiring a hard iron to resist friction, forgings a ductile metal with a certain degree of elasticity. In the mixed varieties of scrap, sorted to the best of the workman's abilities, we are certain to have various qualities, and the more the qualities vary the more do difficulties arise in the perfect welding of the materials. To avoid this difficulty in this present age of steel, we may turn to the making of large forgings of that metal. At first sight the best method would appear to be by casting an ingot of suitable size, and forging it down to the required shape. This has been done to a very considerable extent, and I have made many in this manner, and with fair results.

It will be admitted that a hospital is the best place for a young student to study the profession of surgery. Will it not as readily be admitted that a manufactory of forgings, where we are constantly receiving the old or defective shafts, is the most likely place to learn what is the most suitable material for their manufacture, witnessing, as we do, most frequent failures of forgings of various descriptions, and carefully investigating the causes? My own experience points to some of the worst failures having been steel shafts made from a solid cast ingot. At the works with which I am connected, we have a great number of steel shafts of various sorts sent in after being condemned. In most cases these shafts have broken very suddenly without giving any previous warning; others have exhibited some very slight mark or crack, after the discovery of which it was not safe to work them a day longer. Now an iron shaft will show some flaw or other marks before it breaks. These flaws may be watched, and can be traced from time to time, and thus sufficient warning is given to enable the necessary repairs to be put in hand and got ready without causing any delay or serious inconvenience. It is certainly far better for all concerned—shipowners, engineers, and passengers—that a forging should give notice rather than fail suddenly.

My attention was first drawn to the manufacture of forgings of larger sizes from puddled iron by the tempting offers at which influential iron merchants solicited me to purchase puddled bars for that purpose. This at once led me to consider the qualities most suitable, and the best way to make forgings, more especially shafting. After a fair consideration, I decided that the use of puddled iron of the very best kind, on which is bestowed the necessary amount of work, insures the most uniform material, and produces the best quality it is possible to make in iron, if iron be the best material. This cannot be accomplished by using the lowest priced pig iron, or by buying puddled bars, but by purchasing the best all-mine and cold-blast brands of pig iron, puddling it in your own furnace, and then following the practice, so long carried out by the best Yorkshire manufacturers, of breaking every puddled slab after shingling, and selecting only those that are of a uniform quality, and free from blisters or dirt. Within the last few years I have made many tons of shafts from this material, and they have given general satisfaction. It is scarcely necessary to mention that forgings made from this material are much more costly than those made from scrap iron in the usual manner, as we are enabled to secure a more uniform material than we could obtain by combining a variety of unknown pieces.

Only a few years since I produced some steel of a very superior quality, which was tested in every conceivable manner. It was of the description called by our President "ingot iron," but even with it the manufacture of forgings from a large ingot was costly and tedious; and seeing that this metal could be readily wielded, I was led to try some experiments in that direction.

At first I had very little faith in this for the manufacture of large forgings, as I had, in years gone by, tried the welding of steel in all forms. I had the pleasure of being connected with the Crewe Works for many years from the commencement of that justly-famed establishment, and at the starting of the steel works there (carried out by the eminent engineer whose name is so well-known all over the world, Mr. John Ramsbottom, the manager being at that time Mr. F. W. Webb, the present able superintendent of the London and North-Western Railway Company), I, as Mr. Webb's assistant, under his orders, took entire charge of the rail manufacture, and, in addition, had to inspect the manufactures of various works carried on outside the railway company's own establishments. I thus had the opportunity of noticing the various modes of manufacture at different works, and I must say that the best iron I saw manufactured was the Yorkshire brands. I think it was at the meeting of the Mechanical Engineers, in Manchester, in 1866, when the Crewe Works were visited, that I took our President, Mr. Menelaus, and a few other gentlemen, to see the steel-headed rails then being manufactured by a process patented by Mr. F. W. Webb. These gentlemen could not credit that a perfectly serviceable weld could be made, so to prove this to them a piece was broken off a rail, and flattened under a steam hammer, on end, to nearly half its original length without separating the steel from the iron, and by this means conviction was forced upon them. It may, perhaps, be interesting to say a few words as to the manner in which this welding was accomplished. We flattened the crop-ends of rails down to thin bars after they were cut from the steel rails. They were then piled together in various ways by themselves, a layer of thin bars made from rail ends, with puddled bars made from hematite iron brought from the puddling furnace, very young, with steel turnings between each layer, and also iron turnings between each layer of rail ends; but the hematite puddled bars appeared to unite most kindly with the thin bars of rail ends, no doubt because they were made from a similar description of ore to start with. These different processes were adopted for the manufacture of the steel-headed rails with a desire to utilise the crop-ends of steel rails. In the case of the rails examined on the occasion referred to, the steel slab was rolled down from a cast ingot, and had the hematite puddled bars piled between it and the old rails to complete the rail pile. The analysis of these steel slabs showed that they contained from ·3 to ·35 per cent. of carbon. I am, however, now convinced that the metal made by the Bessemer, Siemens-Martin, or other processes, if properly treated, will weld better by itself than if mixed with any other material or flux.

Having now gone over the ground of these various modes of manufacture, I revert again to the uniform material.

I at one time thought that "compressed steel" was the material of the future for the manufacture of irregular shaped forgings. I have now come to the conclusion that as the pressure only consolidates the crystals, and closes the honeycomb cells, it may be regarded as a most valuable way of improving steel containing honeycombs, and admirably adapted for castings of all descriptions; but for forgings it is far preferable to make the metal free from honeycomb to start with. It is afterwards most important to convert the crystalline into as fibrous a nature as possible, and this is better done by rolling than by any other known process.

I now take the ingots, made of a specially mild quality of steel, and roll them down to bars, so that a fibrous material is the result, and the crystals originally in the ingot are got rid of. These bars are sheared into suitable lengths, and piled together in order to make the required forging.

It will therefore be seen that all the keels, stern-frames, &c., which are of very awkward shapes, can now be readily made of steel, so that we may have vessels built entirely of this material, whereas hitherso they have been only partially so constructed.

I have prepared samples of four different descriptions of iron, and of four different lots of steel; and in order to make all these compare as fairly as possible with one another, I have not simply cut pieces out of the steel shafts, but have cut an end off, which has been drawn down to the required sizes under the steam hammer by the same workmen who have prepared all the others.

(*To be concluded in our next Number*).

GOVERNMENT ORDER FOR ANCHORS.—Mr. Wastenays Smith, Newcastle-on-Tyne, has just received from the Admiralty orders to fit Her Majesty's ships *Rover*, *Eclipse*, and *Hydra* with patent stockless anchors, in consequence of the favourable reports received on the large one in use on H.M.S. *Garnet*, on the South American station for more than twelve months. The principal feature of this anchor is that, unlike all other anchors, it has no stock, and, when holding, both arms are always in the ground, the holding power being thus enormously increased. This anchor has been steadily growing in favour, and is now used by various foreign and colonial governments, and by the leading maritime companies of the world, including the Cunard Company, P. and O. Company, Union Steamship Company, &c. Over 400 of these anchors have already been made, and a large number have been specified for new steamers about to be built.

A REVOLVING SHIP CLEANER.

A VAST amount of ingenuity and research has been expended upon the endeavour to discover a species of paint or covering for ships' bottoms, which would prevent fouling, but hitherto nothing has proved very effective. The condition in which vessels frequently arrive home from the tropics is sometimes almost deplorable. Grass a foot long is found to be growing on the ships' bottoms under water, and incrusted very largely with molluscs and barnacles. The molluscs and barnacles would not, we believe, adhere if the first coating of grass and vegetable matter was prevented from adhering.

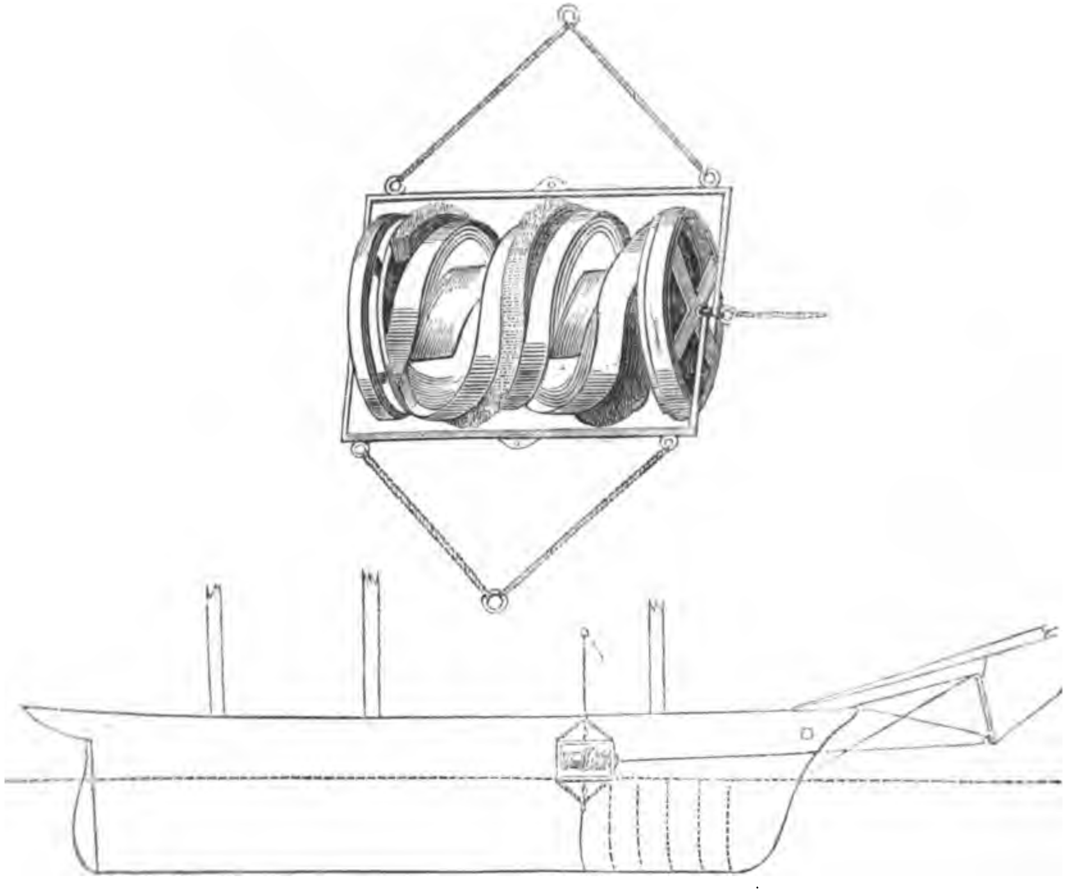
We illustrate herewith an ingenious revolving brush, which has been invented for the purpose of keeping the bottoms of vessels clean from the moment of their leaving port, so that the incrustation should not have a chance of commencing to form. This revolving brush is the invention of Messrs. Cutlan & Son, but it has been practically applied and introduced by Mr. Cloid, of the firm of Cloid, Routledge, & Co., since 1878.

The apparatus consists of a floating hollow cylinder, shown in detail in our illustrations, which has a helical or Archimedean screw around it. The cylinder is surrounded by a spiral brush or scraping knives, as may be desired, and is mounted in a frame in which it is capable of rotating freely. The flow of the water through the screw on the cylinder causes it to rotate at a speed of about 100 revolutions per minute, when the ship is going four or five knots an hour, although it may be used with perfect efficiency with a flow of not more than two to three knots an hour when the ship is anchored in a tide way. The apparatus is guyed by three ropes. One of hemp is attached to the forward end of the frame, and is reeved through a pulley block at the end of the martingale and thus carried back on deck again. This forms the tow rope, which is slacked out when the drum is in sight on the surface through the distance of the length of the drum for each travel down from the water line to the keel. An up and down guy line of ¾ inch iron wire rope is attached; one to the top of the frame by which the frame is lowered away from the deck, and the other is attached to the bottom of the frame, and, passing under the keel, is taken up on deck on the other side, by means of which the drum is hauled down from the water line to the keel.

A succession of traverses up and down may thus be made from water line to keel until the whole of the ship's bottom is completely cleaned. The brushes are made port and starboard, and, should the quarter be very hollow, a small line should be passed from the after part of the machine round the stem, which would thus give the brush well up to its work.

If the vessel starts clean, and is kept clean at sea or immediately after leaving harbour, the brush alone will suffice to keep the bottom perfectly free from incrustation. But should there by any chance be an accumulation of barnacles, spiral scraping knives can be easily fitted to the revolving drum so as effectually to scrape any barnacles off.

The value of this apparatus must be very apparent to ship-owners, as the accumulation of weeds frequently found on a vessel from the tropics would be sufficient to take 2 or 3 knots out of the speed of the vessel. For the under writers, too, it would be a satisfaction that the normal speed of the vessel could be relied on throughout the voyage. Again, expensive lifting, scraping, and cleaning would be almost entirely saved with the constant use of an apparatus like this, as it does not in any degree injure the paint, if only the brush is required. A most satisfactory trip was undertaken at the end of last year to exemplify the merits of the invention to a representative of the Admiralty, one from Lloyd and others interested in shipping. The apparatus worked with perfect ease, and the result was an effectual cleansing of the ship's bottom.



A CENTRIFUGAL CIRCULATING PUMP.

ONE of the latest improvements in sea-going engines has been the adaptation of independent circulating pumps, instead of the old-fashioned condensing pumps worked from the engine shaft. There is much to recommend the adoption of this system.

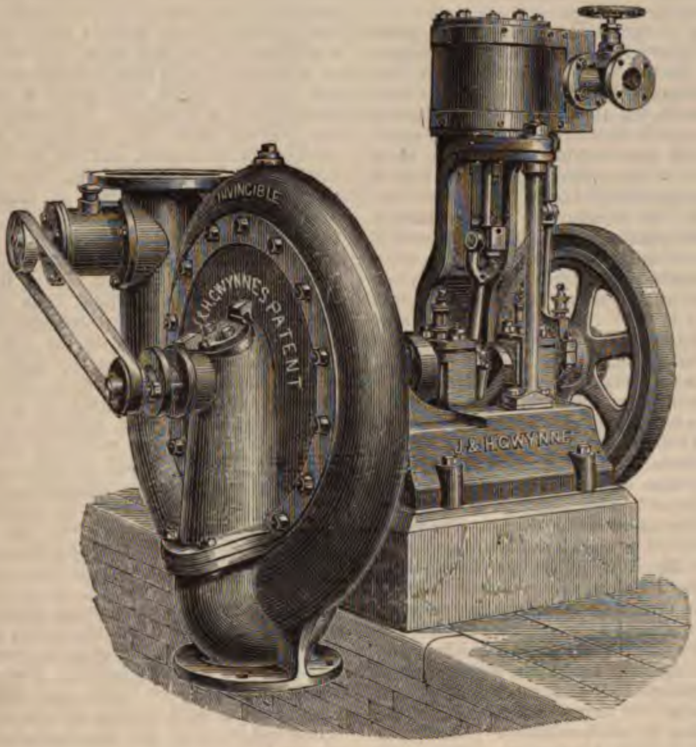
As the speed of the shaft of a large engine is comparatively slow, a bulky and expensive pump is required to circulate the proper amount of water required for the condenser. If an independent engine is used, the speed may be increased indefinitely, so that the requisite amount of water may be supplied from a much smaller machine. As engine room space is also generally very limited, and a point of great value would be the utilization of any odd corner not occupied, the advantage of an independent pump instead of one part of the engine is obvious.

In a pump driven from the main engine the only available arrangement for varying the flow of condensing water is by means of opening and closing the injection cock. But this has the bad effect of throwing a back pressure on the pump, thus taking as much power to drive when only a small quantity of water is required as when it is doing its full work.

The circulating pump we illustrate is that of Messrs. John & Henry Gwynne, Engineers, of London, who have introduced many successive improvements since their first adaptations of centrifugal pumps to this purpose some eleven years ago.

We had much pleasure in attending a most successful trial of the new 15 inch engine we illustrate at Messrs. J. and H. Gwynne's Hammersmith works, where the said engine worked at a sufficient speed to deliver 3,500 gallons of water per minute through a height of 35 feet. This engine and another on a similar design have just been made for the two new steamers now building by Messrs. J. Elder & Co., and Barclay, Curle & Co., of Glasgow, for Messrs. Donald, Currie & Co.'s Royal Cape Line.

The engine and pump are bolted to a very deep and rigid bed-plate which not only gives great steadiness to the working parts, but in a measure dispenses with foundations. The cylinder and slides are of the very best mixture of cold-blast and Scotch iron; the connecting eccentric and slide rods are of the best hammered steel; the cross-head and piston-rod are of one piece of steel; the valve spindles work in guides; the crank shaft (double bearings) is worked out of a solid block of steel; the pump spindle and disc is of gun-metal (when required); and all the 3-inch bolts and nuts are steel hardened.



The journals have all large bearing surfaces, and the reciprocating parts are carefully balanced. Each engine is supplied with starting valves, a set of steel spanners, condensed water cocks, impermeator, and an improved system of lubrication is attached to all the bearings.

We may sum up the advantages of these engines to be be: 1st, That the pump can be stopped and started instantaneously, independent of the main engines; 2nd, The quantity of water passed through the condenser can be regulated with the greatest nicety, and the condenser kept at an even temperature.

vacuum can be obtained in the condenser before the engine has started. 3rd, No injection cocks are used, and the work expended on the pump can be exactly regulated to the water required. 4th, The circulating pump can be applied to empty the bilge and water ballast whilst still continuing to pump through the condenser. This is very valuable in case of leakage. 5th, The space occupied is extremely small. 6th, The parts are simple, and little liable to damage. 7th, As the pump engine exhausts into the condenser, atmospheric pressure of the steam is frequently sufficient to work it, thus requiring very little power.

A YACHT FOR THE CZAR.

A STRIKING originality is shown in the costly steel yacht which has just been laid down for the Czar in the largest shipbuilding yard on the Clyde, that of Messrs. John Elder & Co., of the Fairfield Works, near Glasgow. The Popoff ironclads have been fully described in our columns, but the new vessel differs very considerably from them in form, and is expected to differ very much from them also in sea-going and gun-carrying capacities. It is true that, in spite of the rumours to the contrary, the yacht herself is not to be equipped with any more powerful guns than 4-pounders for saluting, nor to be defended by any armour. But steadiness and comfort have been the main objects in designing her, and if the *maximum* of steadiness is secured in a pleasure yacht of a certain form, the addition of armour-plating and modifications not difficult to make might supply on the same principle the most stable floating gun-carriage. It is no secret that the yacht is an experiment, and that the great interest taken in her by the chief of the Russian Navy, the Grand Duke Constantine, eldest brother of the Czar, was largely due to the fact that she is an example of a novel system of construction which it is his work to bring into practical use. The yacht's gross burden is 7,700 tons, and her displacement with coals on board for five days is 3,920 tons. The precise lines on which she has been planned were settled as the result of a long and careful system of trials undertaken by Dr. Tidman, of the Royal Dockyard of Amsterdam, in conjunction with Admiral Popoff, of the Imperial Russian Navy. The plans were then submitted to and approved by the Grand Duke Constantine, who, after receiving from Mr. William Pearce, the head of the firm of John Elder & Co., the builders, the assurance that the vessel could be constructed in the form determined by the Amsterdam experiments with a speed of at least 14 knots, laid the designs before the Czar, and received for them the sanction of His Imperial Majesty. The vessel is now being built under the supervision of Captain Goulaeff, of the Russian Imperial service of Naval Architects. There is an apparent but unreal coincidence in the fact that the late Mr. John Elder, in 1868, exhibited plans for a circular ironclad at the United Service Institution. This vessel has nothing in common with the man-of-war then projected, but she may be regarded as a development of the class of vessels which Admiral Popoff, under the encouragement of the Grand Duke Constantine, has produced. No Popoff ironclad approaching the size of the new yacht has ever been built; no Popoff ironclad has been seen in this country; and those which have been constructed in Russia differ from the yacht by their completer roundness of form and much greater immersion. The new yacht will be a palace raised on an enormous hollow steel turbot. The lines of the turbot-shaped raft on which the palace will be built sweep round in front into a pointed bow or beak; at the sides they expand so as to give a wide and spacious area to the back on which the superstructure is to be raised; at the stern they again come to a point. At the widest part the breadth is 153 ft., more than 3·5ths of the length, which is 230 ft. The depth of the fish-like raft in the centre is 18ft., and the water-line is only 6ft. above the lowest point. At the stern, however, a small depression, making a draft of 16ft. in all, is effected to give the screws water to work in. This part of the ship may be lifted to cross shallows, such as those, for instance, at the mouth of the Dnieper, on the way to Nicolaieff, by flooding the fore compartments, and arrangements for quickly effecting this object will be made. There is no freeboard, properly so called. Stability is given by breadth and weight. The bottom has a flat area of 14,500 square feet. At the edges the surface trends out and upwards all round the ship towards the water-line. But as soon as the ordinary water-line is reached, by gradients which equal 6ft. perpendicular, a change is made in the direction of the curves. The outward slope is succeeded by a slope inwards, which continues till the perpendicular depth of 18ft. has been given to the whole substructure. It gradually rises to this all round, and in the middle of the back of the fish there is a wide flat space of about 15,000ft. Such is the floating raft on which the water-palace of the Czar is to be borne, not on a bat's back like Ariel, or on a dolphin's like Arion, but on a light steel turbot full of air. The air will be stored, for the sake of safety, in innumerable close compartments. The object of the re-entering slope will be easily understood. The wash of the waves against a straight or overhanging wall encounters a resistance, in overcoming which the waves shake to and fro the vessel which thus opposes them. But they will run up the new yacht, and so lose their force before reaching the upper structure. In view of the failure which has overtaken ingenious attempts already made by more than one eminent engineer to secure steadiness at sea for the comfort of passengers or for certainty of aim in war, it may not be prudent to write over-boldly of the attainment of stability by the means which have just been described; but the Popoff ironclads are found to be very steady; those persons most concerned speak with absolute confidence of the new yacht, and the experiments of Dr. Tideman at Amsterdam with solid paraffin models will be supplemented in a few days by a small steel model of the yacht, 23ft. long, which is nearly ready at Fairfield. The yacht herself will next June receive her engines while lying in Messrs. Elder's spacious dock at their works after her launch, and will be ready in the following month for her trials in the estuary of the Clyde and the North Channel, to be succeeded by her trip, with an illustrious party on board, to the Black Sea.

The lower body or raft of the vessel will be built entirely of mild Siemens steel, with a water-tight double bottom, 3ft. 6in. deep in the centre, and 2ft. 6in. at the extremities. There will be a double row of water-tight cells along the sides. The motive power will be supplied by three screws. Three keels run in straight lines lengthwise underneath the fish-part of the yacht, one in the centre, the others 18ft. to the right and left of the central keel. Above the keels there are, in the interior of the vessel, three propeller shafts, terminating in screw propellers of manganese bronze, combining great strength with lightness. There will be three sets of engines to work the three screws. To secure fixity for the engine-seat, it will be made in one with the frame of the ship, all of malleable iron and steel. The engines will be the lightest for their power in the world, the condenser of sheet brass, the piston-rods, and bolts all over the engine, of mild steel. The boilers are about to be made by Messrs. Elder of steel manufactured by Messrs. Charles Cammell and Co., of Sheffield; the furnaces and other internal parts are to be of Bowling iron, the tubes of brass. The use of manganese bronze, a material of great tensile strength, for the blades of the screw, is expected to save 4 per cent. of friction. It is not known that screws of large size have been made of this material before. The diameter of the propellers is 16ft.; they have four blades, and 20ft. pitch. Of the two outside screws, one is right-handed and the other left-handed. The middle screw will be about 2ft. 6in. further aft than the side screws. The screws being more than one-half of their diameter below the flat bottom of the ship, they will work in undisturbed water, and not, as is usual, at a disadvantage in water broken by the passage of the hull. As at the point where the screws are the draught of the ship will be, in a small projecting portion, 16ft., and the engines are towards the bow, where the draught is 6ft., it is necessary to slope the propeller shafts. The middle shaft will be sloped at an angle of 2·7deg., or will fall about 1ft. in 20ft. The total length of the shaft is 150ft., and the total fall exceeds 7ft. The other shafts are sloped proportionately. The nine boilers, three to each screw, will contain about 400 tons weight of water, and are therefore placed amidships. Here also are the coal bunkers. The horse-power is to be 10,500; the speed attained, 14 knots; but a greater power and greater speed will, it is expected, be developed. The engines are of about equal power the one with the other. There will be but one rudder, and that will be abaft the central screw, the side screws being adapted for the steering of the ship and regulated from the bridge.

The bridge belongs, of course, to the upper portion of the vessel laid upon the steam propelled, air-inflated, steel fish which has been described. This upper portion more nearly resembles an ordinary ship in shape, a ship which supports a double row of wooden deck-houses. It is of steel and wood, 260 ft. long and 110 ft. wide at the broadest portion. It will be observed that it is a little longer than the raft below. The ends coincide where the two portions join, but the bow is of clipper form, trending forward and hence slightly extends the length. At bow and stern the superstructure coincides in width with the raft, but speedily retreats from the latter's broad and swelling outline, and at the centre is narrower by 43 ft. than the raft on which it rests. That is to say, the raft at this point bulges out 21½ ft. on the right and the same distance on the left from the ship, as if the vessel's hold had taken a lateral expansion. Just at a point where the junction between the upper and lower portions of the composite vessel is effected by a bracket frame connexion in what may be called the lower deck—a mere wooden floor erected above the rounded steel deck, partly open and partly closed, which forms the upper surface of the raft. On the forward part of this wooden deck will be the capstan for the anchor and crew space. Ventilators for admitting air to the raft will open through the deck and be carried up by tubes, and forward also will be a large cabin for the lower class of stewards, whose berths will be arranged on each side of it on the sides of the ship. The side cabins will be lighted by large rectangular windows (3 ft. 6 in. high and 2 ft. 6 in. wide), provided with flaps to close in rough weather, if necessary. A little forward of amidships the deck is broken by the hatchway for the engines. It is no less than 48 ft. broad and 20 ft. long; the sides are carried up a little higher than the roof of the upper deck-house. The same disposition is adopted with the three boiler hatchways, which are side by side amidships and each 26 ft. by 32 ft. Aft of the boilers are galleys, aft of them officers' cabins, and the spacious ward room is right in the stern with a balcony overhanging the water, from which to observe the effect of the screws. Above this first wooden deck comes another, the space between them being about 9 ft. Forward on this main deck, and so escaping all noise or smell from the engines, are the dining and drawing-rooms of the Czar, with private apartments at the side for the Imperial family. The whole of the deck is surrounded by a covered gallery for promenade. The dining-room will be 65 ft. long, 35 ft. broad. and 12 ft. high, and will, like the other reception-rooms, be of unprecedented magnificence. The after-house will contain apartments for the aides-de-camp and ladies-in-waiting, with their saloon overlooking the sides and stern of the vessel. The roof of the covered gallery affords an open promenade, and above the houses another story or set of houses will be erected. The upper house forward will contain a grand reception-hall and bedrooms for the Emperor and Empress, with cabins for their servants. The after-house is to contain the study and reception rooms of the High Admiral, the Grand Duke Constantine, with two private cabins for the captain of the ship. The hatchways of the engines and boilers will open above the loftiest of these houses, the gigantic cowls for ventilating them rising still higher, with the three great funnels behind them side by side. The flying bridge will command a view above the roof of the highest houses. The height from the keel to the roof on the second story of the deck-houses will be about 46 ft., or from the inside of the double bottom, 42 ft. 6 in. The yacht will carry three swift steam launches, two lifeboats suspended at the edge of the raft, aud other boats. Long rows of steps lead from the deck, and down the sloping sides of the raft to the boats. The yacht will be manned by a crew of 260.

All the cabinet work and joiner's work required for finishing and ornamenting the elaborate superstructure of the floating palace will be done in Messrs. Elder and Co's yard, where the work of a similar character, the wood-carving, brass-moulding, &c., was completed for the Orient, the Arizona, and other great passenger ships built there. The yacht makes the 231st of the vessels constructed with their engines at these works since 1856, and the 121st from the beginning of 1870, when Mr. William Pearce, the present head of the firm, first joined it. The list includes many ironclads and other vessels for the English, Dutch, and other Governments, as well as the greater portion of the fleet of the Pacific Steam Navigation Company, and other great mercantile enterprises. The tradition of good and thorough workmanship still lingers among shipwrights, but in the case of the Russian Imperial yacht the Scottish workmen will be directed in the decorative portion of their task by Russian or Parisian artists. The new yacht will afford employment during the course of her construction to about 2,000 men, and will increase the roll of labour at this yard, which, in the days before the depression of trade set in, has employed 6,000 men on more than a mile and a half of shipping, to about 6,000 men. The yacht is placed amicably side by side with two steel sloops of war, the *Rambler* and *Ranger*, and a steel despatch boat of shallow draft, the *Niger*, which Messrs. Elder and Co. are constructing for the British Government. A new Cape mail steamer, also of steel and exceeding 3,000 tons, for the Donald Currie line; a paddle boat for the Dutch company which works the Flushing route, to steam 17½ knots, with two steel steamships for the British and African Steam Navigation Company, are also building in the yard. The progress of steel as a material for maritime construction and the re-assertion of British supremacy in shipbuilding could not be more conspicuously illustrated.

TORPEDO WARFARE AT PORTSMOUTH.

THE long expected sham naval battle came off at Portsmouth on the 16th of last month. The event had been postponed on several occasions owing to unsuitability of the weather and other causes, and even on this occasion the gun-fire on shore was only represented by the explosion of detonating charges, owing to the severe illness of a high official in the neighbourhood. The fight took place in the roadstead at Spithead, commanded by the forts Gilkicher and Monckton, and the attacking enemy were supposed to have forced the passage of the Needles, and to be making a night attack on the dockyard.

The enemy were supposed to be obliged to pass through a passage 1800 yards in width. In this passage a channel was necessarily left for the supposed traffic of neutral or merchant vessels, the rest being thickly laid with contact mines or torpedos, so as to be almost hopeless for passage. It was, however, in the neutral channel that the principal struggle took place.

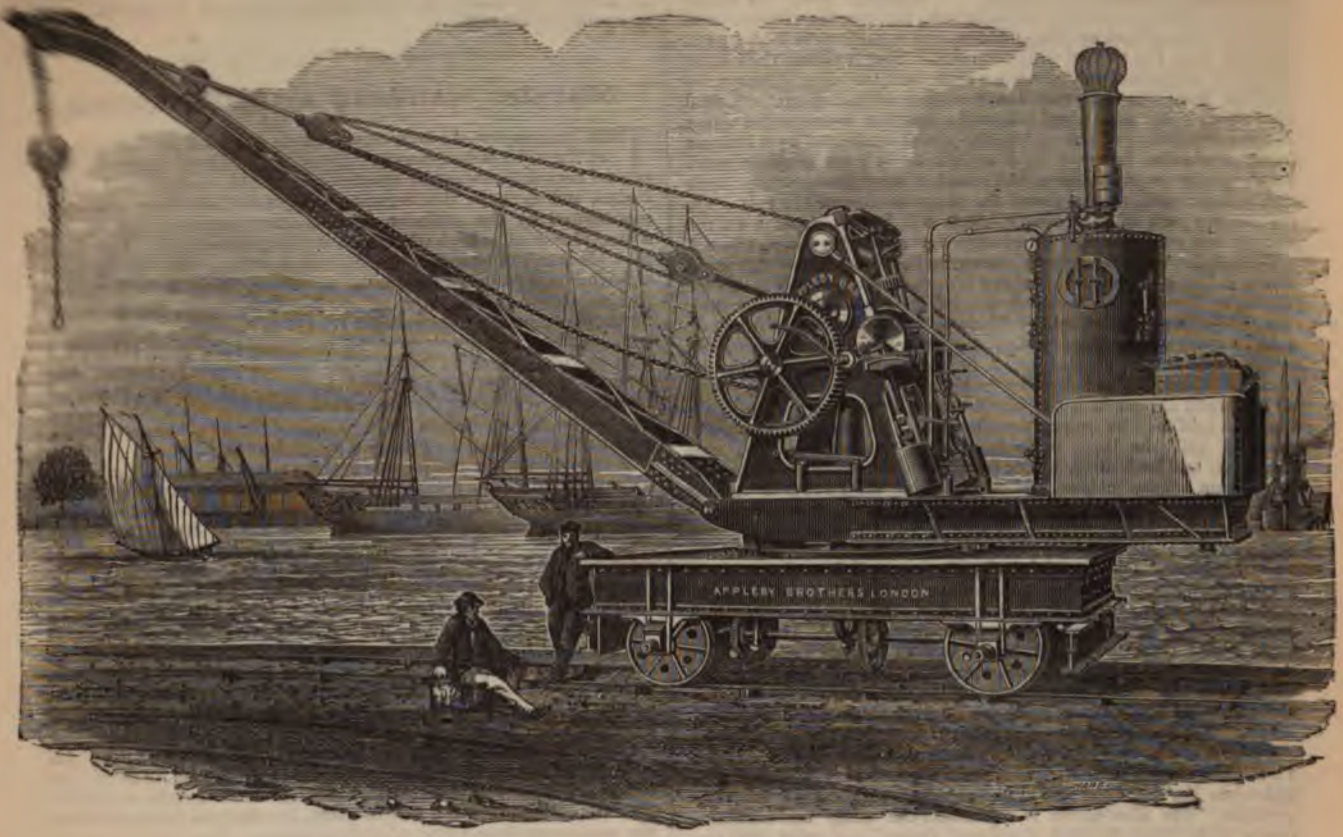
A heavy boom of 600 yards in length and made of timber, 10 inches square was laid right across the passage, protecting all the wires and connections of the Observation and other torpedoes. The first business of the attacking force was to break this boom. As, however, this boom was situated under a raking fire of artillery and small arms, and was also illuminated by an electric light from the fort on shore, it was a work of much exposure to attempt to attach a bursting charge to this boom. Six launches were detailed for this business, but they were all soon rendered *hors-de-combat* by the fierce artillery and small-arms fire to which they were exposed. One of them, however, towing a small boat, succeeded in attacking a charge of dynamite to the boom, which, on explosion, made a gap sufficiently large for the gun boats to pass through.

It now devolved upon the *Bloodhound*, *Lightning*, and *Vesuvius* to enter the breach in the boom, and to clear away the Observation or other torpedoes within to make a passage for ironclads to follow. The *Bloodhound* was the first to essay, but she was disabled before she could even drop a line of counter-mines. The *Lightning* succeeded in cutting a large number of electric wires, and in dropping some counter-mines, but was disabled before she could explode them, in spite of her high speed and low hull. The *Vesuvius* was a little more successful, as she actually laid a complete line of counter-mines and exploded them, so that she practically cleared a channel of 30 feet in width.

As this, however, was scant room for an ironclad to pass in, it has been decided that the attack did not succeed.

Of course all the torpedoes were more imaginary in their explosion than real to prevent accident. For the full bursting charge of a torpedo is 500 lb. of powder, whilst the charges used were only 2 lb., just to indicate explosion. The whole passed off very successfully, the electric and other lights giving great vivacity to the scene.

RAISING SUNKEN VESSELS.—In the Plötzen Lake, which is not far from Berlin, and the depth of which is very considerable, reaching in some parts to 28 metres, an interesting attempt has been made to raise sunken vessels. The method, which is the invention of Herr Eidner, a Vienna civil engineer, consists in applying carbonic acid in the following manner:—In an empty balloon a bottle half filled with sulphuric acid, surrounded with Bullrich's salt, is fixed; the bottle is destroyed by turning a screw, and the two substances mix, and produce carbonic acid which fills the balloon. It is obvious that when this apparatus is brought into operation in the hull of a sunken vessel, the effect must be, if a sufficient number of balloons are filled, to raise the vessel. In the experiments on the Plotzen Lake a small vessel, or boat, weighing several hundredweight was first sunk. A diver then went down with the necessary apparatus, which he set in operation in the interior of the ship. Hardly had he done so before the vessel began to rise to the surface, where it was maintained by the balloon. In a second experiment five heavy sacks filled with sand were thrown overboard in a part of the lake which was 16 metres deep. The diver descended, fastened all the sacks together, and fixing the balloon apparatus to them, set it going, with the effect that the whole of the sacks were brought to the surface.



DOCK STEAM CRANES.

THE employment of adequate appliances for prompt loading and delivery of cargoes at docks or wharves is a subject of the greatest importance to more individuals than would be first supposed to be affected thereby. We may enumerate these as the dock owners, the ship owners, the railway companies, the manufacturers, merchants or buyers of the goods to be transferred, and so on.

There is only one broad choice of arrangement by which this prompt unloading can be best carried, it must be either by fixed or portable mechanical appliances. The fixed appliances of any kind would be always open to the objection that each ship must always be moored exactly under each crane or unloading apparatus, and that there must be one apparatus for each berth alongside.

Messrs. Appleby's wharf cranes are well-known, and the one we illustrate with this issue is mounted on wheels, and carries its own driving and lifting power. It will lift up to 10 tons. There is much to be said in favour of this system of locomotive steam cranes in preference to the fixed cranes before referred to. Vessels may be moored as close together along the quay as space will permit, and a few locomotive cranes will be able to serve them all.

The illustration is from a crane in use at the East and West India Docks, where it has done and is still doing excellent service. All motions, viz: lifting, turning, altering radius, and travelling are performed by a pair of direct-acting steam cylinders placed slightly on an incline, one outside each frame. The crank pins are fitted into balanced disc plates; each cylinder has link reversing gear, and the piston rods are guided by blocks working in bored guides cast to the cylinder covers. The post is of wrought-iron turned to fit the revolving bed which carries the side frames. The feed-water tank and vertical boiler are carried from the revolving bed, and are placed at such a distance behind the post as to form a counter-balance to the load to be lifted. The lifting power is conveyed from the crank shaft to the chain barrel by spun-gear, and the load may be lowered by reversing the engines or by the brake. The turning motion is obtained by double friction clutches, and the crane may be moved in either direction, simultaneously with any other operation. This motion is performed by driving the friction roller under the jib instead of through teethed gear on the carriage, which much reduces the risk of breakage. The derrick motion is obtained by a worm and tangent wheel on the chain-barrel, the worm locking the jib in any position. The travelling motion is conveyed from the crank-shaft to both axles by a train of shafts and bevil wheels, one shaft passing down the centre of the post. The whole of the work is well-fitted, and has a large margin for strength.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES (ENGLISH).

Flamsteed.—On the 19th September, Messrs. Bartram, Haswell and Co. launched from their iron shipbuilding-yard, at Sunderland, an iron screw steamer of 2,850 tons burthen, for Messrs. Wilkie and Turnbull, of North Shields. She has been built under special survey, made to pass for the highest class in the London and Liverpool Registry—100 A 1, and 20 years. The principal dimensions are:—Length between perpendiculars, 285 feet 6 inches; breadth, 35 feet 2 inches; depth, 24 feet 6 inches; the gross register tonnage being 1,950 tons. The vessel is specially designed for the American and Indian trades. In addition to an iron deck the upper deck is principally of iron, on which is laid a yellow pine deck. The plating is also strengthened above the rules. She will be fitted with one of Mr. Dickinson's compound surface condensing engines of 160-horse power, and provided with all the latest improvements in marine engineering. The boilers are made to bear a very high working pressure. One of the most noticeable improvements is that the vessel will be steered by steam, by a patent steam steering apparatus placed on the deck-house amidships. The ceremony of christening was performed by Miss Drake, of Huddersfield, who named the vessel the Flamsteed.

Beignon.—On the 29th of September, there was launched from the yard of Palmer's Shipbuilding and Iron Company, Jarrow, a new screw-steamer, of the following dimensions:—Length between perpendiculars, 240 feet; breadth, 33 feet; depth of hold, 17 feet. The accommodation for the Masters and Officers will be aft, that for the Engineers amidships, and for the Crew in the topgallant forecastle. The vessel, which is for Messrs. Morel, Brothers and Co., Cardiff, has been built under special survey, and will be classed 100 A 1 at Lloyd's. Her engines, which will be supplied by Palmer's Company, will be of 120-horse power nominal, and her carrying capacity will be about 1,800 tons. The steamer is intended for the general carrying trade. She was named the Beignon by Miss M. A. Armstrong, daughter of Mr. Robert Armstrong, manager of the shipyard department of the Company.

Cumbrian.—On the 30th September, there was launched from the shipbuilding-yard of Mr. Robert Thompson, jun., at Southwick, Sunderland, an iron sailing barque, built to the order of Peter Iredale, Esq., of Liverpool. The following are the principal dimensions:—Length, 214½ feet; breadth, 34.4 feet; depth of hold, 21·3; 1,050 tons nett register. The vessel has been built under the special superintendence of Lloyd's surveyors to class 100 A 1. She has a raised quarter deck and monkey forecastle, large iron deck-house amidships, fitted up for Crew and Apprentices; cabin aft, fitted up for Captain, Officers, and spare berths; and is fitted with all the latest improvements for a vessel intended for the Indian and China trade. She was christened the Cumbrian, by Mrs. James E. Thompson, of Thornhill-park, Sunderland.

Aludra.—On the 30th Sept. there was launched from the shipbuilding-yard of Messrs. Mounsey and Foster, South Dock, Sunderland, an iron screw steamer of the following dimensions:—Length B.P., 249 feet; breath extreme, 33 feet 6 inches; depth in hold 18 feet 6 inches; gross tonnage, 1, 500; class 100 A Lloyd's. She has been built to the order of R. H. Penney, Esq., of Shoreham, and will carry about 2,050 tons deadweight. Water ballast tanks are fitted in the fore and aft holds and in the after peak, capable of containing 270 tons in all. The main and quarter decks are of iron. The cabin, with accommodation for Captain, Officers, &c., is fitted aft under quarter-deck, whilst the Engineers are berthed at the after end of a long bridge, and the Crew under a topgallant forecastle. She is schooner-rigged, with the lower mast of iron, and is fitted with four-cylindered steam winches for discharging cargo, and all other recent improvements. Her engines which are supplied by Mr. John Dickenson, of Palmer-hill Engine Works, are on the compound surface, direct acting principle, are of 130-horse power nominal, and 596 effective, the cylinders being 31 and 57 inches respectively, and the stroke 36 inches. The ship received the name of the Aludra from Mrs. Poole, wife of Captain Poole, under whose superintendence the vessel has been built.

Spinaway.—On the 30th September Messrs. Cottingham Bros launched from their yard at Goole a trawling smack, of about 80 tons register, for Mr. C. Pickering, Coltman-street, Hull. The vessel was named the Spinaway, and has been built to class 10 years A 1 at Lloyd's.

Argosy.—On October 1 Messrs. M. Pearse and Co. launched from their iron shipbuilding premises, Stockton, an iron screw steamer of the following dimensions, viz:—Length between perpendiculars, 275·0; extreme breadth, 35·6; depth from underside of upper deck to top of floors, 24. Vessel has a gross tonnage of about 1,900 tons, with a carrying capacity of about 2,500 tons. Has been built under special survey, and stands in the highest class granted by Lloyd's; is built off the three-decked rule, with two decks laid, the upper one being of yellow pine and the main deck of iron. She is flush-decked, with bridge and chart-houses amidships, and topgallant forecastle for crew. She is schooner-rigged, with double topsails on the foremast, the lower masts are of iron. She is fitted with double bottom for water ballast in fore and after holds; complete steam midship steering gear, and three double cylinder horizontal steam winches, and one double cylinder steam crane—all with connections to donkey and main boilers, besides other appliances for expeditiously loading and discharging cargoes. The engines, which are on the compound principle, are of 150 horse-power, and are supplied by Messrs. Blair and Co., of Stockton. The vessel is built for local owners, and as she left the ways received the name of Argosy, this ceremony being performed by Miss Hodgson, of West Hartlepool.

Ardington and *Gleadowe.*—On the 2nd October two screw steamers were launched from Messrs. Palmer's yard at Jarrow. The first was the Ardington, built to the order of Messrs. Lee, Finch and Co., Cardiff. The steamer is 235 feet long, (between perpendiculars) 32 feet broad, and 17¾ feet deep. She has been built under special survey, and will be classed 100 A 1 at Lloyd's. The christening ceremony was performed by Mrs. Finch, wife of one of the owners. The second vessel was the Gleadowe, which has been built for Messrs. Hunting and Pattison, Quayside, Newcastle. The dimensions of the Gleadowe are as follows:—Length 285 feet; breadth, 37 feet; depth, 24½ feet. The carrying capacity of the Gleadowe will be over 3,300 tons. The ship was christened by Mrs. Thomas Jones, of Durham.

Screw Steamer.—On October 4, a screw steamer of the following dimensions:—Length, 146 feet; breadth, 22 feet; depth of hold, 12 feet; estimated to carry 500 tons deadweight (built to the order of Mr. E. Beale, of Cardiff), was launched from the shipbuilding yard of Messrs. Osbourne, Graham & Co., Hylton, Sunderland. The steamer, built especially for the French and general Coasting trade, is fitted with water ballast, steam winches, patent windlass, and all the latest improvements to secure economy in working expenses and despatch, and will be supplied with a pair of 65 nominal horse-power, made by Messrs. George Clark & Co., Southwick Engine Works, Sunderland.

Wolviston.—On October 14, Messrs. W. Gray & Co. launched from their yard at West Hartlepool an iron screw steamer, built to the order of the West Hartlepool Steam Navigation Company, and the second designed on the same model built for the same company this year. Length between perpendiculars, 256 ft. 6 in.; breadth 34 ft. 6 in.; depth of holds, 19 ft. 9 in. by 24 f.t 3 inches gross tonnage 1,760, will carry 2,350 tons of cargo; classed 100 A 1 in Lloyd's; engines, 150 horse-power, by Messrs. T. Richardson & Son, of the Middleton Iron Works, Hartlepool. The new vessel is supplied with complete double bottom for water ballast, full poop, raised quarter-deck, bridge, and top-gallant forecastle for crew. As she left the ways she was christened Wolviston by Miss Frances Mary Young, daughter of Captain Young, Managing Owner.

Ballogie.—On the 15th October a steamer named Ballogie was launched from the building-yard of Messrs. Hall, Russell & Co. The steamer, which has been built to the order of Messrs. J. and A. Davidson, of Aberdeen, is intended for the Baltic trade, and is 1,019 tons gross register. In length it measures 225 feet, in breadth 30 feet, and in depth 10 feet, and it will class 100 A 1 at Lloyd's.

Derwent.—On the 16th October there was launched from the shipbuilding-yard of Mr. Robert Thompson, jun., Southwick, Sunderland, an iron screw steamer of the following dimensions, viz.:—Length (Board of Trade), 329 feet; breadth extreme, 36 feet; depth of hold, 25 feet, 6 inches, about 2,500 tons gross. The vessel is for the Royal Mail Steampacket Company, London, and has been built under Lloyd's special survey to class 100 A 1, and the Board of Trade for passenger certificate. The engines have been built by the North-Eastern Marine Engineering Company (Limited) of this town, and are on the inverted direct acting compound surface condensing principle, of 300-horse power, and include steam starting gear, and turning gear by donkey engine. She has three decks, two laid of iron, the upper one being covered with wood; has a full poop, bridge, and topgallant forecastle, and an iron wheel and chart-house on bridge. She is fitted throughout with all the latest improvements; has four holds with all necessary water ballast, and large fresh water tanks and condenser. The cabin will be fitted out for a large number of first-class passengers, and also accommodation for second-class passengers, a bridge house amidships, with galley and berths for accommodation of Officers and Engineers, and a topgallant forecastle for Seamen and Firemen. She has steam winches and cranes for discharging cargo, &c., with extra large horizontal boiler; also Harfield's Baxter patent steam windlass, with capstan connected. As the vessel left the ways she was christened the Derwent by Miss Mabel Thompson, daughter of the builder.

Cleveland.—On October 16, an iron screw-steamer, named the Cleveland, was launched from the shipbuilding-yard of Messrs. R. Craggs and Son, at Middlesbrough. The vessel has been built to the order of Messrs. Jervelund and Clephan, of Middlesbrough, and is intended to become the pioneer of a new line of steamers trading between Copenhagen and Middlesbrough. Her length over all is 177 ft. 6 in.; breadth, 25 ft. 3 in.; depth in hold, 17 ft. 10 in.; with a carrying capacity of 700 tons. She is classed 100 A 1 at Lloyd's. The steamer is fitted with cabin amidships for passengers, and with moveable furniture for conveyance of cattle, corn, butter, &c. from Denmark. Her export trade will be principally iron. The engines are compound surface condensing of 90-horse power, by Messrs. Blair and Co., of Stockton. The new line will open up direct communication between Middlesbrough, Stockton, Darlington, and other Tees-side places with Denmark. Special arrangements are made for ventilation of holds. The steamer has two decks, double bottom, water tank, all fore and aft, divided into four compartments, and supplied with patent steam windlass and winches, and all the latest improvements for loading and discharging cargo. The steamer was christened the Cleveland by Miss Mellanby, of Stockton.

Colina.—On the 16th October, a screw steamer was launched from the yard of Messrs. Robert Irvine and Co., West Hartlepool. Her extreme length is 280 feet, her beam is 20 feet, and the nominal horse-power of her engines (to be put in by Blair and Co., of Stockton) will be 140. She has a deadweight capacity of 2,350 tons on a mean draught of 20 feet, and her gross registered tonnage is 1,650. There are four steam winches by Irvine and Co., an iron bulwark along the bridge, and all the latest improvements. This vessel has been built for the American and East Indian trade, and is owned by Robert Irvine and Co. As she left the ways she was named Colina by Mrs. Irvine.

Maxima.—On the 16th Oct. an iron screw steamer was launched at Pallion, Sunderland. She is called the Maxima, *pro tem.*, and has been constructed in the yard of Messrs. Doxford and Sons. Her gross carrying is stated at 3,600 tons, her capacity net tonnage being about 2,300. The length of the Maxima is 372 feet, she has a 40 feet beam, and the depth of the hold to the upper deck is 31 feet; she has been fitted with three iron decks on the spar deck rules, and a space of 8 feet divides each deck. Her class will be 100 A 1 at Lloyd's. The Maxima will be engined and entirely fitted up by Messrs. Doxford and Sons. She will be rigged as a three-masted schooner; her engines will be on the inverted direct-acting compound surface-condensing principle, of 400 nominal and 2,000 indicated horse power. The cylinders witl be 48 and 84 inches diameter respectively, and the stroke will be 54 inches. Three double-ended boilers will be placed in her, so as to obtain great steam power, and it is anticipated that the vessel will be propelled at a speed of 12 knots an hour. She will also be fitted with five steam winches, one multitubular boiler. and steam stearing gear; has been adapted to carry water ballast in high tanks, and will have a double bottom under the engines. The Maxima will probably be engaged in the American trade.

Viola.—On October 16th a screw steamer was launched from the yard of the Tyne Iron Shipbuilding Company (Limited), at Howdon. As the vessel left the ways she was named the Viola by Miss M. Williamson, of North Shields. The dimensions are:—*Length, 280 feet*; beam, 36 feet; and depth, 24 feet 6 inches. Her engines will be 180 horse-power, and combine all modern improvements. She has four steam winches on board, and her burthen will be 2,000 tons. Messrs. Joseph Robinson & Co., of North Shields, are the owners.

Cosmos.—On October 17th Messrs. A. and J. Inglis launched from their shipbuilding-yard at Pointhouse a saloon paddle-steamer of the following dimensions:—Length, 250 feet; breadth 33 feet; depth, 11 feet; tonnage, 1,000 tons. The vessel, which was christened Cosmos by Mrs. Kerr, is built of steel throughout, and is intended for traffic on the River Plate.

Scotch.

Dredger.—On September 30, a new iron double dredger of 700 tons, built and engined by Messrs. W. Simons & Co., was launched complete from their works at Renfrew, It is the property of the Corporation of Hull, and will dredge to 30 feet depth, and is fitted with compound engines of 100 horse-power, and steam appliances throughout.

Mary Monica.—On the 1st October the Mary Monica was launched from the shipbuilding-yard of Messrs. Murdoch & Murray, Port Glasgow. The dimensions of this iron screw steamer are 170 by 23 by 13·6 feet; 375 tons register. She has been specially constructed for the coasting trade to the order of Messrs. J. and J. Young, engineers, Ayr, who will furnish her with compound engines of 70 horse-power. After the launch she was towed to Ayr.

Buenos Ayrean.—On the 2nd October the Buenos Ayrean, the largest steel vessel in the world, was launched from the shipbuilding-yard of Messrs. William Denny & Brothers, at Dumborton. She is specially built to the order of Messrs. James and Alexander Allan, of Glasgow. Her length between perpendiculars is 385 feet, breadth 42 feet, and depth 34 feet 2 inches. Gross tonnage 4,040 tons. She is built to the highest class, A 1 at Lloyd's. Her engines are 500 horse-power, and her boilers are the largest steel boilers ever made. The Buenos Ayrean is intended for the development of the cattle trade of the River Plate and Canada. It is noteworthy that up to the present time no attempt has been made to construct steamers at all approaching the dimensions of this one of steel, and her future movements will be watched with interest by those concerned in the mercantile shipping of this country.

M'Millan.—On the 2nd October, the Messrs. A. M'Millan and Son, Shipbuilders, Dumbarton, launched from their shipbuilding-yard a sailing-vessel named the M'Millan, after the senior member of that firm. The vessel is 260 ft. in length by 38-3-ft. beam, and 24½ ft. deep. She has full poop, topgallant forecastle, and house on deck. All the erections on deck are of iron, and the ship is built considerably over Lloyd's rules for the highest class. She is fitted with steam winches and pumps. As she left the ways she was named by Mrs. Robert M'Millan, wife of one of the members of the firm.

Malaga.—On the 14th October Messrs. Alexander, Stephen and Sons, launched, at Linthouse, Govan, an iron screw steamer, of the following dimensions:—265 by 33 by 20, and gross about 1400 tons; built under special survey to Lloyd's 100 A 1 class, and highest class in Bureau Veritas. This steamer, which was named the Malaga by Miss Kemp, Overbridge, Bellahouston, has compound surface-condensing engines of 150-horse power nominal, fitted on board before launching, and will be an addition to the fleet of Messrs. Robert M. Sloman and Co., of Hamburg.

Belair.—On the 16th of October, Messrs. J. and G. Thomson launched, at Greenock, a screw steamer for Messrs. David Caw and Co.'s direct line between the Clyde, Trinidad, and Demerara. The new vessel is named Belair, after the well-known sugar estate in Demerara. Her principal dimensions are:—Length, 253 ft.; breadth, 32 ft. 6 in.; depth, 19 ft. 7 in. She is built to the highest class at Lloyd's, has accomodation for passengers in the poop, and is especially constructed for carrying sugar cargo. Her tonnage is 1,800 tons, and her engines, which will be supplied by the firm, will be 800-horse power. She will be under the command of Captain Boniface, late of the Eldorado (s).

Irish.

Lord Dufferin.—On the 1st. of October the Lord Dufferin, a new iron ship of large dimensions, was launched from the yard of Messrs. Harland & Wolff, Belfast. She had been built to the order of Messrs. Thomas Dixon & Co., Belfast. After the Lord

Dufferin had reached the water, she was hauled into the Abercorn Basin, where she will receive her masts and rigging, all of which will be fitted up with the latest improvements. The Lord Dufferin is sister ship to Lord Cairns, and will be engaged in the foreign trade.

TRIAL TRIPS.

Pouyer Quertier.—This new telegraph ship, built by Messrs. C. Mitchell & Co., left the yard on September 20th, for trial at sea, also to have her compasses adjusted. Amongst her visitors were Captain Maypee, representing the owners; Mr. Brittle, representing the telegraph company; Mr. W. Dobson, representing the builders; Mr. T. Clark, representing the engine builders; Mr. Taylor, Board of Trade Surveyor; Mr. P. McGregor, Lloyd's surveyor; Mr. T. Atkinson, Bureau Veritas surveyor; Mr. Farina, of Messrs. Farina and Bushell, consulting engineers; Mr. R. Norton, Messrs. C. Mitchell & Co.'s superintendent engineer; Mr. Wm. Wilson, &c. An average run of 9¾ knots ahead, and 7¾ astern was obtained. The party adjourned to the saloon, where luncheon was provided. The usual toasts for the success of the owners, builders, and the telegraph company were proposed by Captain Maypee, and responded to by Mr. Dobson aud Mr. Farina. The vessel was then tried in her turning powers. The Pouyer Quertier has two pairs of engines, which drive independent screws. She has been constructed for repairing submarine telegraph cables, and has two large cable tanks, built with a view to her requirements for that purpose. She is also fitted with all the latest improvements, including about a mile of Chadburn's patent telegraph, and bells fore and aft, and fitted with John Hastie & Co.'s (Greenock) steam steering gear. Although built of much smaller dimensions than the Hooper and the Faraday, the Pouyer Quertier will be as useful and much handier than either. On leaving the vessel, the company gave three hearty cheers to the Pouyer Quertier, which was lustily responded to by the officers and crew. She then steamed away to London, and arrived at the Nore in twenty-seven hours.

Longhurst.—This screw steamer, owned by Messrs Elliott, Lowrey, and Dunford, went on her trial trip on the 24th of Sept. A party of gentlemen left the New Quay, North Shields, by a tug steamer to join the vessel outside, when a very successful run was made to the Coquet Island and back. The distance was done at a mean speed of 10½ knots, both engines and vessel doing remarkably well during the voyage. The vessel was built by Messrs. J. Wigham Richardson and Co., of Low Walker, to carry a dead weight of over 3,000 tons. She is replete with every appliance for economical working of ship and cargo, having steam winches and steam steering gear. The engines, which are by Messrs. R. and W. Hawthorn, of 180-horse power, worked most satisfactory.

Norfolk.—The steamship Norfolk, belonging to Messrs. Money Wigram and Sons, of Blackwall, and destined for the Australian trade, made a trial of her engines on the 25th of September. The Norfolk has been built by Messrs Green, of Blackwall, and is what is termed a three-deck ship, differing from the ordinary spar-deck vessel. She is constructed on the girder principle, and of enormous strength, having floors of considerable depth and thickness. Her masts are of iron in one length, with yards of steel. Her cabins give accommodation for about 500 passengers, in addition to which there is room for about 2,000 tons of cargo and 1,300 tons of coal. She is to be commanded by Captain J. Pyne O'Callaghan. Her dimensions are as follows:—Length (extreme), 345 feet; breadth, 40 feet 1 inch; depth of hold from main deck, 32 feet 9 inches; height, between decks, 7 feet 9 inches i tonnage. 3,000 register. Her engines have been fitted by Messrs. Humphrys, Tennant, and Co.. of Deptford, of the four cylinder compound principle, of 500-horse powder nominal, capable of working up to 3,000-horse power. Two of the cylinders are 31 inches bore, and two 76 inches bore, with 4 feet 3 inches stroke. The result of her trial was very satisfactory, averaging over 15 miles per hour under 70 lbs. pressure, and making 62 revolutions per minute. The vessel returned to the West India Dock, whence she will start for her first voyage on the 18th October.

Zoe.—On the 29th September, the screw-steamer Zoe, built by Messrs. Palmer's Shipbuilding and Iron Company (Limited) for Messrs. Burdick and Cook, of London, was taken out to sea for her trial trip. The Zoe measures 234 feet in length by 31 feet in breadth, and 17 feet in depth of hold; her carrying capacity is over 1,600 tons dead weight, and she is classed 100 A 1, the highest class at Lloyd's, the steamship having been built under special survey. She is designed for the general carrying trade between London and the Black Sea, and has a raised quarterdeck, in which the principal saloon and the Captain's and Officers' berths are fitted up. A large house amidship provides accommodation for Engineers, and the crew have quarters furnished in the topgallanf forecastle. The steamer is schooner-rigged, and is propelled by a pair of Messrs. Palmer's inverted direct acting compound surface condensing engines of 100-horse power nominal, which at the trial worked up to 650-horse power with a working pressure on the boilers of 75 lbs. to the square inch. The compasses having been adjusted, the Zoe was taken for a couple of runs over the measured mile ofi Whitley, and the result was highly satisfactory, a mean speed of 9⅜ knots having been obtained, the engines working with remarkable smoothness.

Dalbeattie.—On the 29th September there proceeded to sea from the ship-yard of Messrs. Raylton Dixon and Co., of Middlesbrough, the screw steamer Dalbeattie, which has been built for the Dalbeattie Steam Shipping Company (Limited), to the order of Messrs. E. Harris and Co., of Middlesbrough. She is 250 feet long by 33 feet, by 17 feet 9 inches depth of hold, is 1,387 tons gross register, and will carry 1,900 tons of cargo on a mean draught of 17 feet 6 inches. She is built on raised quarter-deck principle, and furnished with double bottom, both fore and aft, for water ballast; has iron masts and plate iron decks, and large hatchways, four steam winches, and every convenience for rapid loading and discharging of cargo. The cabins for accommodation of captain, officers, and engineers are placed amidships under the bridge, and there are two spare cabins for the accommodation of occasional passengers. Her engines, of 120 horse-power, are by Messrs. T. Richardson and Sons, of Hartlepool. After a two hours' run to near Scarborough, during which a speed of nearly 11 knots was made, the ship returned to dock to load steel rails for Leghorn.

Lambeth.—On the 29th September the screw steamer Lambeth, built by Palmer's Shipbuilding and Iron Company (Limited), Jarrow, for Messrs. T. and C. Nichols, London, had her first trip to sea for the purpose of trying the engines and other machinery on board. The Lambeth, like the steamships Westminster and Vauxhall, built last year by Messrs. Palmer for the same owners, is specially designed to carry gas coals from the Tyne up above the bridges of the Thames to the works of the London Gas Light and Coke Company, Nine Elms, and in her construction several novel features and improvements have been introduced. The dimensions of the steamship are 220 ft. in length, 32 ft. in breadth, and 15 ft. in depth of hold. She is propelled by a pair of compound surface condensing engines of 100-horse power nominal, erected by the Palmer Company, Jarrow. The carrying capacity of the Lambeth is 1,050 tons of coals on a draught of 12 ft. water. The Lambeth was taken a series of runs over the measured mile, and though there was a heavy sea running and a strong wind from S.E. blowing, an average speed of 10 knots was obtained, the engines working up to 650-h.p., indicated, with a pressure of 75 lbs. of steam to the square inch.

Eider.—On 30th ult., the trial trip of the Eider (s), which has just undergone extensive alterations and improvements, took place, the vessel starting at about 9 o'clock in the morning from the Minerva Pier, Hull, and sailing as far as Spurn and back. The Eider, which carries about 240 tons dead weight, is fitted up under the inspection of Lloyd's and the Board of Trade for carrying goods between Hull and Ipswich, in which line she was previously engaged. She has had another boiler put into her, and extensive and thorough alterations and repairs have been made in her machinery and in the vessel generally, the work being carried out by Messrs. T. H. Lee and Co., of Hull. The Eider's speed was found to have been increased nearly two knots an hour with less than half the consumption of coal.

Rhyl.—On the 1st of October, the screw-steamer Rhyl, built by Palmer's Shipbuilding and Iron Company (Limited), Jarrow, for Messrs. John Cory and Sons, Cardiff, had a successful trial trip at sea. The vessel is 240 ft. long, 33 ft. broad, and 18¼ ft. deep. The engines (Palmer's) are of 130-horse power nominal: and the gross registered tonnage of the vessel is 1,364 tons. During the trial a mean speed of 10¾ knots per hour was obtained.

Kingfisher.—The new steam trawler, named the Kingfisher, built by Messrs. D. Allan and Co., Shipbuilders, Leith, for fishing purposes, made her trial trip to North Berwick on October 4. The weather was fine, and much satisfaction was expressed with the seagoing qualities of the little craft. The speed attained was 9½ knots. Her dimensions are 75 by 16 by 8.4. She is classed 9 A 1 at Lloyd's, and her engines are compound surface-condensing of 25-h.p. She is fitted with a steam winch, and is supplied with all the latest improvements for fishing.

Gracie.—On October 7th, the screw steamer Gracie made her official trial trip in the Tees Bay, and afterwards proceeded direct o the Tyne to load her first cargo. This vessel is the third built by Messrs. Edward Withey & Co. of Middleton Shipyard, Hartlepool, for Messrs. Stephenson, Clarke & Co., of London, and has been fitted with engines by Messrs. Blair & Co., Limited, of Stockton-on-Tees. She has been specially designed to run in the coal trade between the Tyne and Thames, and having been fitted with 180 horse power engines of unusually high power for her size, is intended to make very rapid passages, carrying from 1,850 to 1,900 tons of cargo and bunkers. The principal dimensions are 261 feet by 32 feet by 17 feet, and she has long quarter deck, bridge house, and top gallant forecastle, water ballast in both holds, five large hatchways, three steam winches and donkey boiler, patent windlass, teak deck fittings, and hardwood cabin. She has been built under Lloyd's special survey, to class 100 A 1. A speed of 11 knots was easily realised with the propeller only partially immersed.

Norman.—On the 15th October the trial trip of the screw steamer Norman, built by Mr. C. Mitchell & Co., to the order of Messrs. Henry Clapham & Co., of Newcastle, took place. The Norman is built especially for the Bilbao iron ore trade, and her dimensions are:—length, 210 feet; breadth, 30 feet; depth, 10½ feet. The engines are by the Wallsend Slipway and Engineering Company (Limited), of 100 horse-power, with steel boilers, and all the latest improvements for efficiency in working and economy in consumption. The ship plates, angles, and boiler plates of the steamer are entirely of steel, manufactured by the Weardale Iron and Coal Company, (Limited). This vessel has been built under the special inspection of Lloyd's Surveyor, and the materials have undergone most stringent tests.

Griper and *Tickler.*—On October the 17th two gunboats which have been received at Portsmouth for the Pembroke yard, concluded their six hours' contractor's full-power trials, under the superintendence of the officers of the Steam Reserve. With an average of 154 revolutions the Griper indicated 189·3 horses, and realized a speed of eight knots, the consumption of coal being 3 lb. per unit of horse-power. The Tickler, with 149 revolutions, indicated 185·7 horses, and secured a speed of 7·8 knots, the consumption of coal in this case being 8·4 lb. The contract revolutions were 140 and the contract power 168. No steam blast in the funnel was used on either trial. The specified power was easily obtained without it, and might have been increased to 220, had it been thought necessary to press the machinery. The difference in the consumption of fuel per unit of power is accounted for by the fact that in the Griper's trial the wind was abeam with a force of from three to four, while on that of the Tickler it was alternately ahead and astern with a force of from six to seven. The engines, which are of the simple type, are precisely similar in both vessels. They were fitted by Messrs. John Penn and Sons, of Greenwich, who were represented at the trials by Mr. Gosling. The Griper and the Tickler are to be placed in the gunboat reserve for use at a day's notice.

Gannet.—On the 18th October the iron screw steamer Gannet, built by Messrs. M. Pearse and Co., at their shipbuilding yard at Stockton, had her trial trip prior to leaving the Tees for Hamburg. The steamer is 245 ft. long, 33 ft. beam, and 17 ft. 9 in. deep, being fitted for water ballast throughout. Her net register tonnage is 804 tons, 1,245 tons gross, and capable of carrying over 1,400 tons. She is specially designed for passenger and goods traffic, together with accommodation for horses and cattle. The vessel has been built to the order of the General Steam Navigation Company, London, and Captain Minchell assumes command. Her engines, by the firm of Messrs. Blair and Co., of Stockton, are on the compound surface-condensing principle, of 150-horse power nominal, with a working power of 900-horse, being fitted with Durham's volometer and steam-turning gear and Chadburn'a patent reply telegraph. Steam is also applied to the steering appliances of the ship, whilst all the officers' berths are supplied with steam stoves. For the expeditious discharge and loading of cargo the steamer has two steam winches and four steam cranes, together with a steam windlass for the use of the vessel. The storage for cattle and horses is arranged on the main and 'tween decks. There are berths for about 50 first class passengers. In the forward part of the ship the second class passengers' berths are fitted to accommodate about 40 persons.

ON THE CLYDE. An order has been received by Messrs. John Elder and Co. from the British and African Steam Navigation Company for two steel vessels, each of 1,500 tons. The Clyde Shipping Company will add a steamer of 1,000 tons to their fleet. Twelve new vessels were ordered last month on the Clyde, making 53 now in hand.

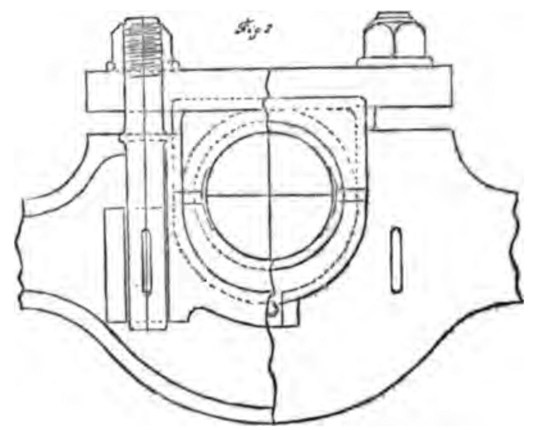
Correspondence.

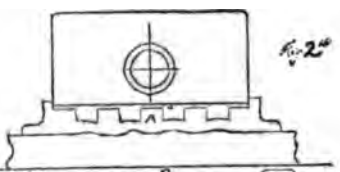
[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.* ED.]

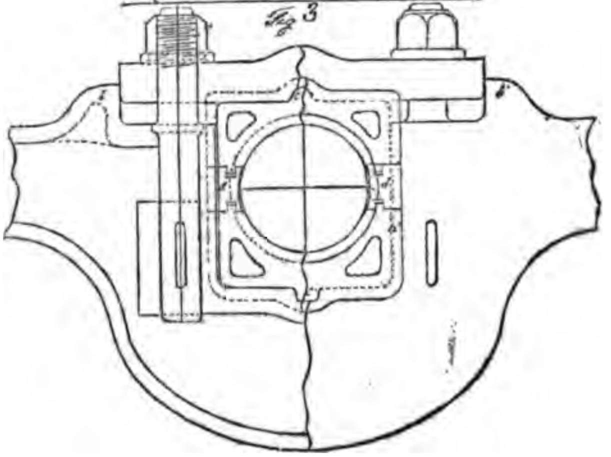
To the Editor of the MARINE ENGINEER.

MAIN CENTRES OF MARINE BEARINGS.

SIR.—As a new subscriber, I beg the insertion in your next issue of a description and illustration of the present, and, I shall hope, the future main centre bearings of all powerful engines, (Fig 1.), is the now common mode by most marine engine-makers, for the simple reason of giving facility to overhauling, on removal of the bottom brass by placing the engines in position, taking off the top brasses, easing the weight of the shaft off the bottom brasses by hydraulic jack or other power; turning the bottom brass round to the top of the shaft for examination, &c., and with this style of bearing, after being several times hot, has the exaggerated appearance of (A Fig 2) the distance here shown between the brass and the pedestal (A Fig. 2), is caused by not allowing for the difference of expansion and contraction at the same and different degrees of temperature of the three metals in contact. Before illustrating (Fig. 2) I will first give the system of management of bearings (Fig. 1), and bearings without the clearance shown in (AA Fig. 2), by most all sea-going







engineers, and which fact all consulting engineers should be aware of. We will then take for convenience a crank-shaft bearing with any engineer on duty, who finds the reported bearing can no longer be kept cold without water, the hose is then applied, the chief engineer fancies with the water the bearing is getting hotter; this is not fancy, for such is the case, the water is contracting the brass against the expanded shaft, and the shaft is trying to free itself from the tightness of the brasses caused by the contraction through the application of cold water; the engines are then slowed down, (excepting the great Atlantic steamers whose engineers are no strangers to the hose), the pedestal bolts slackened; then, after a few hours, full speed is resumed. In port, this brass is taken out, the sides cut away to give the usual clearance between the shaft and the sides of the bearing. Placed in position again the space (A Fig. 2) is filled up with liners, the engines are again in motion, commencing again to heat, and, in a short time require new brasses being broken through in the bottom. The bearing (Fig. 2), is designed to obviate all this (AA Fig. 2) is ¼ inch clearance between each side of the brass, and the pedestal to allow for the difference of expansion and contraction at different degrees of temperature (CC Fig. 2), are snugs on the brass, the cap being supported by the snugs (BB Fig. 2), keeps the brass in position, and allows it to expand from the centre line, (DD Fig. 2), are liners about the same thickness as what is allowed, for the usual clearance. Space not permitting of further details, I briefly state what I particularly claim for the bearing (Fig. 2) is that the engineers may do in the shop what the engines do for themselves at sea. J. H.

PRIMING IN MARINE BOILERS.

DEAR SIR,—It has occurred to me that perhaps some of the practical readers of your valuable journal might be able to give me some good advice in a small difficulty. I am engineer of a small coasting steamer, and am very much troubled with one of my boilers. It is a comparatively new multitubular boiler, and will persist in priming very much. If there is any sea at all, the priming is much increased, so that it requires constant carefulness at the engines to prevent a smash, through water in the cylinders. Can any of your readers give me advice as to how I may stop this priming, and oblige, A PUZZLED ENGINEER.

Reviews.

The Naval Architect's and Ship Builder's Pocket Book. By Clement Mackrow, A.I.N.A., published by Messrs. Crosby, Lockwood & Co.

This is a neat and compact *vade mecum*, for reference in all matters of ship-building, mechanics, and analagous subjects. There is no doubt that a pocket-book of this description must be necessity in the ship-building trade, as much as a Molesworth is found to be in ordinary engineering profession. The contents consist, in the first instance, of some very elementary definitions and preliminary subjects, such as definitions of the usual algebraical signs and symbols, exercises in decimal fractions, and problems in geometry. We think, however, that these chapters will prove as valuable as the more advanced and technical one further on, as there is no doubt that concise instructions in such matters will be greatly appreciated by naval draughtsmen, who are often more practical than theoretical. The practical geometry gives some capital examples of how to set out the different geometric curves, such as cycloïd, hypocycloïd, parabola, neoïd, harmonic, cissoïd, conchoïd, and involute of a curve. The example of development of curves from intersections will also prove invaluable to the naval draughtsman. Passing on, we find an excellently concise chapter on solution of triangles by trigonometry, measurements of heights and areas, and the functions and circular measure of different angles. Of the more technical character are the "tables of tonnages of vessels from builders' measurements," "Board of Trade Regulations for Ships," and the displacement tables of ships. The chapter on stability is most excellent and well illustrated, and we should have fewer crank vessels in our marine if these principles were more generally understood by the draughtsmen who have the practical work to do. The chapters on wave and speed trials are equally interesting and useful, and that on sailing must be of great value in enabling the designer to properly proportion the area of the sails and the proper height of their centre of effect above the centre of lateral resistance so that the vessel may not be rendered unstable. There are a large number of logarithmic and arithmetical tables included, which are very handy for reference, and the tables of dimensions of spars and masts are very full and valuable. Though there is not much that pretends to be new in the book, there is a mass of useful information, clearly expressed and brought together within the compass of a handy pocket-book.

Tabulated Weights of Iron and Steel. By Chas. H. JORDAN, M.I.N.A., published by E. & F. N. Spon.

This is a handy little book of extreme thinness so that it could be really carried in the pocket without inconvenience. This cannot be said, by any means, of all the so-called pocket books. Any Marine Engineer, Shipwright, or Architect who has had weights to get out of designs will thoroughly appreciate the time and labour saved by having a book such as this at the elbow, from which the weights of angles and beam iron can be ascertained. Every variety of shaped material is dealt with so as to save all possible labour, and the weights of rivets and bolts are not forgotton. The printing is clear and good so as not to confuse the eye, but still compressed to the smallest possible space.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from September 19th to October 20th, 1879.

Supplied by the City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

Coating for ships' bottoms and other submerged structures, J. T. Rowe. 3761.
Barometer attachment or weather indicator, W. Hatfield. 3769.
Telegraphic cable coating and devices for aligning and coupling (communicated by P. Arbogast and T. J. McFighe), W. R. Lake. 3778.
Apparatus for imparting progressive and retrogessive motion to vessels immersed in air or water (communicated by W. A. Leggs), W. L. Wise. 3779.
Maintaining ships' berths, &c., level, T. Silver. 3795.
Hoisting apparatus, T. Archer. 3802.
Coatings for ships' bottoms and other submerged structures, G. S. F. Edwards. 3806.
Steam boilers, J. H. Vickers. 3817.
Pipe coupling, W. T. Sugg. 3826.
Splicing wire rope or ropes, W. P. Healey. 3829.
Electrical signalling apparatus (communicated by W. Hadden), A. M. Clarke. 2843.
Economising steam of steam boilers, R. Hanson. 3850.
Compound steam engines, G. K. Stothert. 3860.
Steam boilers, J. H. and W. H., Thwaites, A. Stewart, and J. Sturgeon. 3871.
Steam boilers. C. G. Marston. 3884.
Apparatus for suspending and detaching boats, &c., E. J. Hill and J. L. Clarke. 3887.
Boat lowering apparatus, T. B. Hammond, 3909.
Balancing pendant lamps (communicated by L. Keyling and A. Thomas), J. Imray. 3912.
Pulley blocks, J. Webster. 3924.
Gripping and releasing travelling or running cords, S. Goff and F. Potter. 3936.
Engines and pumps, B. Tower. 3953.
Wrought and cast iron fire bars, J. W. J. and S. Willoughby. 3955.
Boat lowering apparatus and retaining boats in position. J. Hudson. 3958.
Steam boilers (communicated by J. Göhring), G. W. v. Nawrocki. 3985.
Propelling ships (communicated by A. Heel), J. H. Johnson. 4004.
Automatic mushroom anchor, J. E. Liardet. 4006.
Spring and double-acting windlass, J. E Liardet. 4007.
Double grip anchor, J. E. Liardet. 4008.
Taps and pipe joints, J. A. Daniel. 4012.
Valves and taps, W. H. Crispin. 4017.
Lubricants, T. P. Warren. 4021.
Rotary engines (communicated by W. N. de Groat and A. L. Maxwell), B. J. B. Mills. 4031.

Speed governors, R. Waddell and D. Taylor. 4040.
Indicators (communicated by G. H. Crosby), H. J. Hadden. 4045.
Anti-rusting composition and preservation of ships' bottoms and wood work. W. C. Woodhams. 4059.
Water gauges for boilers, T. Hughes. 4061.
Introducing heating and extracting air from feed water of boilers. J. McNeil. 4064.
Water tube steam generators (communicated by C. Ward). A. M. Clarke. 4074.
Ashes lifters for steamers, R. B. Lindsay. 4080.
Increasing speed of working submarine cables, underground wires, &c., T. J. Jones and E. Bull. 4082.
Pipe-joint, G. H. Ellis. 4107.
Diving and Swimming Apparatus, A. Graf and J. Patschke. 4111.
Reefing Sails, H. C. Field. 4130.
Valves and Valve faces, J. Evans. 4149.
Steam Engines, O. Walliss and C. J. Stevens. 4157.
Swimming Apparatus (communicated by A. P. Passet), E. G. Brewer. 4158.
Steam boiler and metal surface preserving composition, J. M. B. Baker. 4159.
Valves and cocks (communicated by C. Schwabe), H. Simon. 4169.
Steam Engines, J. Walker. 4188.
Electric telegraph terminal and shackle insulators, C. E. Crighton. 4189.
Mechanically cooling air in Saloons, &c., J. Bell and J. J. Coleman. 4191.
Steam boilers (communicated by L. Schwartz Kopff), C. Pieper. 4201.
Anti-frictional block bearings, L. Walker. 4209.
Pipe joints, G. H. Ellis and C. L. Light. 4225.
Signaling, controlling and registering steering L. R. and A. Kuechen), H. H. Simon.
Steam hoisting machinery, T. Davison. 4241.
Steam engines, A. Metcalf. 4250.
Valves, W. Unterilp. 4254.
Hoisting and winding apparatus (communicated by A. C. L. Henkel), P. Jensen. 4255.

Notes and Novelties.

AT GOVAN, Messrs. Stephen and Sons, one of the principal shipbuilding firms, have received an order from an Italian house, it is said, for two steamers, each of 3,000 tons burden.

AT PORT GLASGOW, Messrs. John Reid and Co. have contracted for the construction of a large sailing ship for an English firm. She is to be constructed of steel, and will be about 1,200 tons.

ONE or two new orders for iron steamers were received at Low Walker, and one at Wallsend; and an order has been secured at South Shields to build a steamer of above 2,000 tons and 425 feet in length for a North Shields partnership.

GREAT activity continues to prevail on board the armour-plated ship *Superb*, 16, 8,760 tons, 7,430-horse power, which is being brought forward for sea at Chatham, and if the work advances at the present rate, it will not be very long before she is ready for commission. Her armament, which will consist of 16 18-ton guns, is now being placed on board. When built for the Turkish Government, she was only intended to carry 12-ton guns, but when purchased by the Admiralty it was decided to increase her fighting powers, and the alterations necessary to enable her to carry this increased armament have kept her in the hands of the dockyard workmen about 18 months.

UNCERTIFICATED ENGINEERS ON COASTING STEAMERS. At the Liverpool Police-court, on the 30th September, Captain John T. Wilson, of the steamer *Avon*, was summoned under the 5th Section of the Merchant Shipping Act. 1862, for having employed William Green, as the First Engineer, without ascertaining if he had a certificate. Mr. Tyndall (Tyndall and Paxton) prosecuted on behalf of the Board of Trade, and Dr. Commins, barrister, appeared for the defendant. The latter having formally pleaded guilty, Mr. Tyndall stated that, under the circumstances, he would not press for a severe penalty, the prosecution having been directed more as a caution, it being, he had been told, a general practice in coasting steamers to employ Engineers who had no certificates. Dr. Commins, for the defence, stated that his client was not aware, until his attention was called to it at a Board of Trade Inquiry into the loss of the *Avon*, that he was breaking the law, as no articles were signed. The Engineer in question was a most competent man, and he thought this was all that was required. Mr. Raffles remarked that as the law was clear on the subject he hoped the prosecution would have the desired effect. He would only impose, in the present case the nominal fine of 20s. and costs, the full penalty being 50*l*.

THE PULSOMETER ON BOARD THE STEAMSHIP "ORIENT."—A pulsometer is used on board the *Orient* for many purposes, and the following particulars concerning it may interest our readers:—It is erected in the engine-room on the starboard side of the ship connected on the sea and bilge suction, the sea suction running in a line through the ship's side, the bilge running off in two branches—one leading forward of the bulkhead in the main boiler-room; the other drawing water directly under the main engines, to keep the bilge dry from leakage, or from water used on the bearings, washing down water, &c. The 3 inch copper discharge pipe is carried on the main and after deck to be used for washing down decks fore and aft, and for filling tanks for the bath rooms, connections for fire purposes, &c., are also made; it also keeps up a constant supply for the use of all the closets on board ship. The pump is connected to main and donkey boilers by a ¾-inch steam pipe, and can be worked from either at will. It will discharge from the ballast tanks 9,000 gallons per hour; it occupies only the space of the ordinary clack box, and is made fast to the bulkhead; it works noiselessly, which is a great advantage. There are special hand-holes in the covers, and by unscrewing two nuts any obstruction may be removed in five minutes. These hand-holes may also be used for replacing valves without removing main covers.

THE CLYDE SHIPBUILDING TRADE.—Within the last fortnight several large shipbuilding orders have been received by firms on the Clyde, and it is now reported that the Messageries Maritimes Steamship Company have closed a very extensive contract with Messrs J. Elder and Co., who are to build a fleet of ten first class steamers for the Mediterrranean trade. Each of the vessels is to be of 1,600 tons, with great engine power, so as to ensure a high rate of speed. All the ships are to be delivered in eight months, in order to begin the mail contract with the French Government.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Davidson Wm.	2 C	London.
Power, Ed. M.	2 C	do.
Gordon, M. ...	1 C	do.
Blenkinsop, R. J.	1 C	do.
Maw, Joseph ...	1 C	do.
Hyde, R. E. ...	2 C	Lvrpool.
Smart, Donald	2 C	do.
Kelly, Lewis T.	2 C	do.
Spears, Alex. ...	1 C	do.
Tooth, Richard	1 C	do.
Davidson, J. W.	1 C	do.
Orme, Jno. A. ...	2 C	do.
Hutchinson, Jas.	2 C	do.
Holme, James ...	1 C	do.
Robertson, A. ...	1 C	do.
Anderson, Geo.	2 C	Glasgow.
Wiseman, Robt.	2 C	do.
Jamieson, Wm....	2 C	do.
Seabrook, H. T.	2 C	London.
Tardiff, Fredk....	2 C	do.
Rowan, Wm. ...	1 C	do.
Hall, Thomas ...	2 C	N.Shlds.
Wilson, James ...	2 C	do.
M'Neil, Robt. ...	2 C	do.
Cuthbertson, J.C.	1 C	do.
Blundell, Edwd.	2 C	Lvrpool.
Roberts, Hy. O.	2 C	do.
Rouse, Hy. G. A.	2 C	London.
Hammond, John	1 C	do.
Beverley, Geo. ...	1 C	Hull.
Cargill, Jas. S. ...	2 C	Grenock.
Jackson, John ...	1 C	Lvrpool.
Baird, Wm. W.	2 C	N.Shlds.
Stothard, J. B. ...	2 C	do.
Sanderson, Wm.	2 C	do.
Pegg, John ...	2 C	do.
Sharp, Barnsley	1 C	do.
Morgans, W. P.	2 C	do.
Whitworth, E. J.	2 C	London.
Todd, Luke, ...	2 C	do.
Churchman, H.	2 C	do.
Pellew, Nicholas	1 C	do.
Gibson, James	2 C	Glasgow
Will, John ...	2 C	do.
Reid, Thomas ...	1 C	do.
White, Fredrck	2 C	Sndrlnd.
Glen Alexander	2 C	do.
Isaac, Albert ...	1 C	do.
Carlile, Wm. E.	1 C	Lvrpool.
Bourne Anthny.	1 C	N.Shlds.
Cooper James ...	1 C	do.
Humphreys, W.	2 C	Lvrpool.
Oxley, A. H. R.	1 C	do.
Price George ...	1 C	do.
Brown William	1 C	do.
Masson John ...	2 C	Leith.
Dempster, Alex	2 C	Grenock.
M'Intyre Wm. ...	2 C	do.
Scouler, Alex. W.	1 C	do.
Kerr, Thos. ...	1 C	do.
Leslie, Wm. ...	2 C	Lvrpool.

ROBERT JACKSON, Registrar-General.
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, London, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 26th of each month to ensure insertion in the following number.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is Five Shillings per annum. Post Office Orders to be made payable to W. G. Neal, of 3, Amen Corner, London, E.C., at the Ludgate Circus Money Order Office.

The Marine Engineer.

LONDON, DECEMBER 1, 1879.

EDITORIAL NOTES.

ARCTIC enterprise does not seem by any means exhausted yet. In fact it but seems that the desire for exploration in the Northern Icy Seas is but taking a new direction instead of the old well beaten track through Baffin's Bay and Smith Sound. The other evening at a meeting of the Geographical Society an account was read of exploration in the Basents Sea off Nova Zembla. The Swedish ship *Voga* has also last year rounded the Northernmost Cape of Siberia, and a small sailing schooner has succeeded in reaching the hitherto inaccessible shores of Franz Joseph Land. Early in the year Captain Marlebam, R.N., had accepted an invitation from Sir Henry Gore Booth to accompany him on a sporting trip to Nova Zembla. They hired for the cruise the little Norwegian cutter *Isbjom*, a vessel only 55 feet long by 17 feet beam. Her crew consisted of a skipper, mate, two harpooners and five seamen. They reached so high a latitude as 78 deg., 24 min., and six miles further North than the Dutch expedition last year. The trip then was so satisfactory that Captain Markham trusts that a vessel will be sent out to Franz Joseph Land, prepare to winter there, so that starting from that point in the following season it may attack Arctic Exploration from a comparatively new side. We must confess that however reasonable it is to our countrymen to be first in marine enterprises, we cannot see much gain in the repeated losses of life in attempting to penetrate the Arctic Ocean.

WE are still far, it appears, from any settled conviction as to the best form of ironclad for general fighting purposes. There is at least no doubt that the most powerful class of ironclads at present afloat, which are in the form of a low free-board and heavily armoured turret battery on deck, leaves everything to be desired in the way of light, ventilation and comfort. We sincerely pity the unfortunate seamen, officers and engineers who are cooped up in such dismal dungeons, and we are glad to see that there is at least a diversity of opinion as to whether a vessel may not be constructed to be as safe and to fight as well even with large and roomy accommodation as these dreadful floating prisons. H.M.S. *Northampton*, which has just been commissioned at Chatham, is a case in point. The *Northampton* is an improved Shannon, and is constructed to cruise under either steam or sail. Her distribution of armour is special. Instead of as in the *Inflexible*, her battery being most powerfully and in a confined space, a whole deck is devoted to the battery in this vessel and it is not armoured at all; the armour, 9 inches thick, being reserved to render the lower hull shot-proof to five feet below water line, and four feet above, up to the battery deck. There are also two iron bulk-heads, one at each end, 9 and 8 inches thick, to protect the battery from a raking fire. The main battery is thus unprotected on the broadsides, and it is proposed to fire the guns from the conning tower by electricity when they have been once laid, the crew retiring under the armed bulkheads at either end. The hull is divided into about 90 water-tight compartments, and therefore will be very difficult to sink. We are glad to hear that the ventilation is excellent, the engine room and stoke hole never exceeding 88 deg., and the whole accommodation is ample and airy. We rather think that our bold seamen would prefer a comfortable ship such as this, even with considerable exposure under fire, to the close unhealthy dungeons that some of our ironclads have degenerated into.

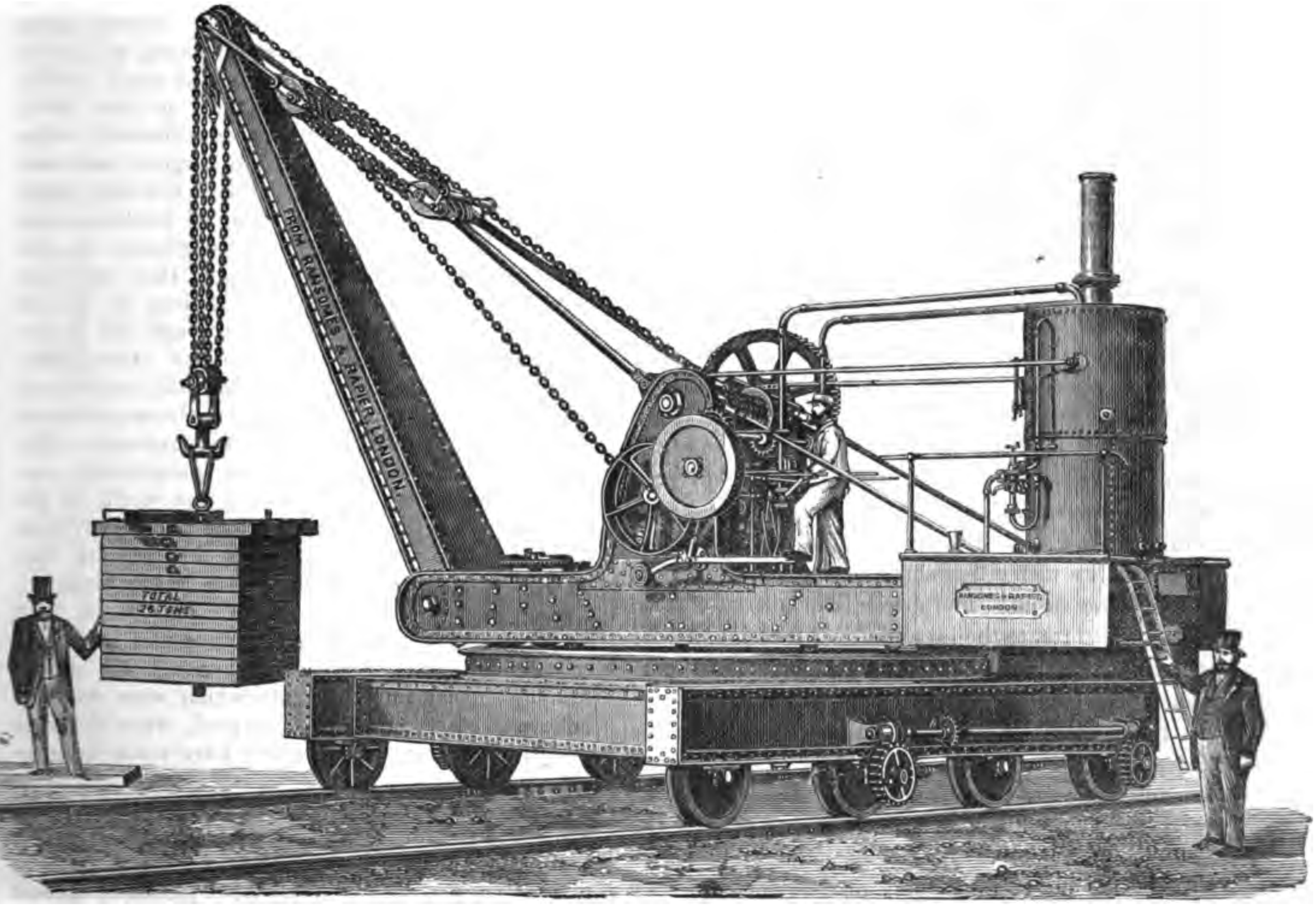
We were much interested in a leader appearing a few weeks' back in an able contemporary on the dynamic power of steam. We drew attention to this subject in our issue of August, in the dynamic energy of steam in the form of a jet, might be practically utilized. In the leader in question this suggestion was worked out showing the affective comparison of a pound of steam used dynamically compared with a pound used statically very much to the advantage of the former. In this case it is not difficult to suggest a mode of application of this form of energy to marine purposes. First for all classes of bilge or other lift pumps,whether in launches or large vessels nothing can be more simple, effective, or economical, than an ejector, utilizing the dynamic force of a jet of steam to discharge the water. Again, it is generally understood that the forward motion of a vessel produced by a screw propeller is the consequent re-action from a column of water forced backward by the screw. And it has also been pretty well proved that the more solid and unbroken, this column of water may be the more perfect is the resulting speed therefrom, as in the case of the De Berry propeller. Now it does require very much mechanical ingenuity to design an arrangement of ejector operated by steam direct from the boiler, which should set in motion an unbroken column of water towards the stern, and thus produce forward motion. This arrengement would be exceptionally applicable to a launch as it could so greatly simplify her mechanism. We do not think that this idea has at any time been practically tested. The apparatus should consist of a tube or tunnel running from stern to stern under the water line. This tube should rise at the centre and narrow to a comparatively small throat. At this point the tube should consist of a special casting by which steam could be received into an outside casing, direct from the boiler, and allowed to wash into the stream of water at the throat of the apparatus. The steam should envelope the stream of water and issue with its full velocity, in the direction in which it is desired to propel the water. This central might easily be made as to enable the steam by a two way cock, to be impelled either towards the stern or the bows, and thus produce a forwards or backwards, motion at will. Should this idea be practically successful it would revolutionize the marine engine trade. We recommend its trials to some of our readers, who may be launch builders.

The Naval engagement in the Pacific, which has resulted so disastrously for the Peruvians, gives rise to many interesting speculations as to the deductions that will be made from the circumstances, by naval engineers. It would seem, from all accounts, that the engagement was conducted with skilful seamanship, and undoubted courage on both sides. The necessity for high speed in fighting vessels is proved by the escape of the Union, an unarmoured corvette, when the Huascar was so disabled as to fall into the hands of her antagonists. Nor did the commander of the Union in any way show timidity. He endeavoured, when the Chilian fleet was perceived through the fog, to distract attention from his less speedy consort by approaching the enemy, and had the fog not suddenly risen the ruse would probably have proved successful and both vessels escaped. As it was, the Huascar found herself obliged to engage with two powerful iron-clads who, according to all theory, should have sunk her with ease in a very short time. This, however, did not prove to be the case and it was not until after a desperate resistance, in which her commander and five of his officers were killed, that she succumbed to the overwhelming odds. The damage she received was considerable. Fire balls had penetrated her side armour at the water line, one of them over the engine room. The turret was struck seven times, three shots indented the plate, two striking obliquely, cut out large pieces of iron ; one pierced the turret leaving two large apertures, bending the side plates, and forcing up the roof. Another burst inside, disabling the gun, and killing eighteen men. It is estimated that but two months are required to put her into complete repair again. This would seem to point to the fact that a vessel is not so easily to be sunk as is imagined and that her protection consists to a lesser extent in her armour and to a much greater extent in her general handiness. The Huascar is a turret vessel of about 1,250 tons, carrying two 300lb Armstrong guns and a complement of small cannon. The two Chilian iron-clads seem to have sustained little damage, and the Chilian Ambassador writes in very high terms to Mr. Reed, their designer, of their handiness and strength. We see that a naval engagement is not always to be guaged by the thickness of the combatants armour, or the weight of their guns. Much still depends on the pluck and skill of the officers and men.

We cannot leave the subject of the Huascar without adding our voice to the general tribute, paid alike by friend and foe, to the gallant conduct of the commanding Admiral Grau. His countrymen in one day subscribed £80,000 in money, jewellery, and plate, and the money will, we hear, be devoted to the purchase of an ironclad to bear his name.

The accident to the Arizona, Guion line, had well nigh proved one of the most disastrous fatalities of the year. It would be premature to express any decided opinion as to where the blame lay, but it would seem that for a vessel so well found as the Arizona, on a clear night, to strike an iceberg of such a size as 600 feet in height and 500 feet across her bows, the watch could not have been so strict as it should have been. Her splendid resistance of this terrific shock speaks well for the build and construction.

The raising of the Grosser Kurfurst seems to become more problematical as time advances, and it now seems out of the question that any attempt to raise her will be made this year. A prolongation of the contract for an indefinite period, by the German Government, appears questionable.



STEAM TRAVELLING CRANE.

It is quite a sign of the increased pace at which we now live, and at which business has to be conducted to see the great increase in the size and number of steam cranes that are now used on wharves and in Docks.

Some years ago it would have been considered sufficiently business like to load and unload vessels entirely by hand, but now the time lost in such manual labours is considered of sufficient value to pay handsomely for the capital required to substitute steam cranes.

The weight of the masses that have to be dealt with are also steadily on the increase, so that the tonnage of the steam cranes is constantly rising. The crane we illustrate is the manufacture of Messrs. Ransomes & Rapier, and is constructed for a load of 25 tons especially for the Australian Goverment.

For convenience of movement, the whole superstructure of the crane and its bearing plate is mounted on a wrought iron truck which has 8 cast steel wheels, so that the superincumbent load, which is 58 tons, is distributed over a considerable area of the road. This load will be increased by the weight of the load lifted, whatever that may be.

Wrought iron rivetted work is used throughout the structure, except in a strong cast iron foundation plate with inner roller path. There is also a second wrought iron roller path, 16ft. in diameter. The crane framing has a wrought iron stretcher both at front and back, and each of these stretchers has two rollers running on the larger roller path. The crane is thus very steady, as the pressure is distributed on the upper frame over three points of support.

The jib is a powerful structure, made of whole iron plates from end to end, and has a radius of from 12 to 30ft., and thus saving joints in the material.

The boiler is put at the extreme end of the bed plate, opposite to the jib, so as to counterbalance the load to some extent.

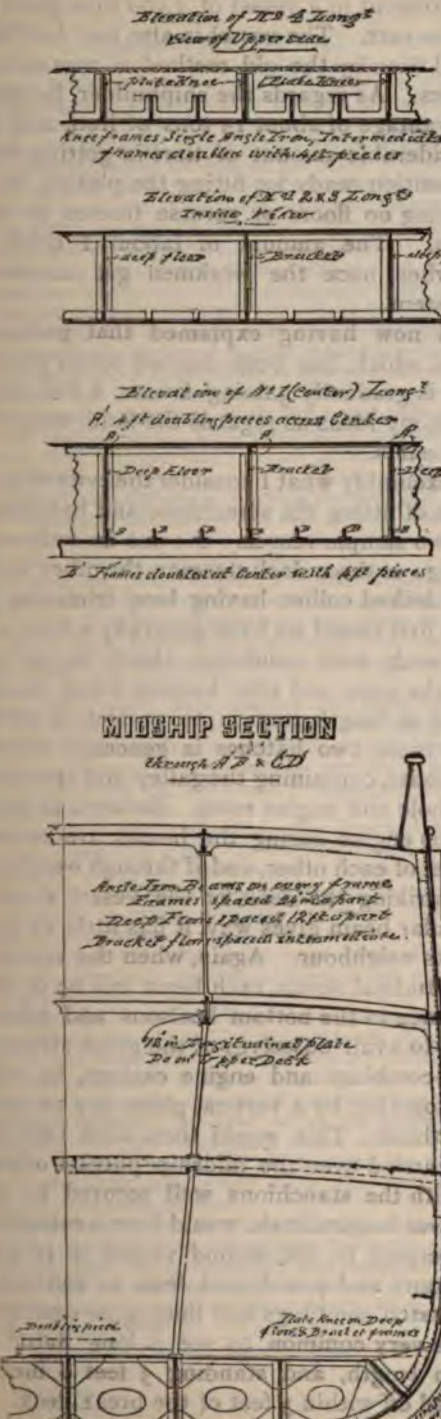
The engine is fitted with two cylinders 8 inches in diameter and 10 inch stroke, and are arranged vertically in the framing, driving on to a first high speed, crank shaft with disc fly-wheel. This fly-wheel shaft is geared up with either single or double purchase to the twisting drum. The engine can also be thrown into gear to rotate the jib and upper frame, and also to drive the lower carriage by a worm and cog-wheel on two of the carrying wheels as shown in the illustration. These worms have a double advantage when so applied. They ensure an ever steady motion to the crane when moving with a load, and they also will act as locking bars to prevent the wheels turning when the crane is required to remain steady for lifting or hauling on boulders or heavy weights at a distance from it.

The load is secured and easily lowered by means of a foot brake which is plainly seen in the illustration, with engine-man's foot on it. The engine-man thus has his hands left free for managing the hauling tackle for reversing, swivelling or going a head. The whole crane is very strongly made, and a fine piece of workmanship.

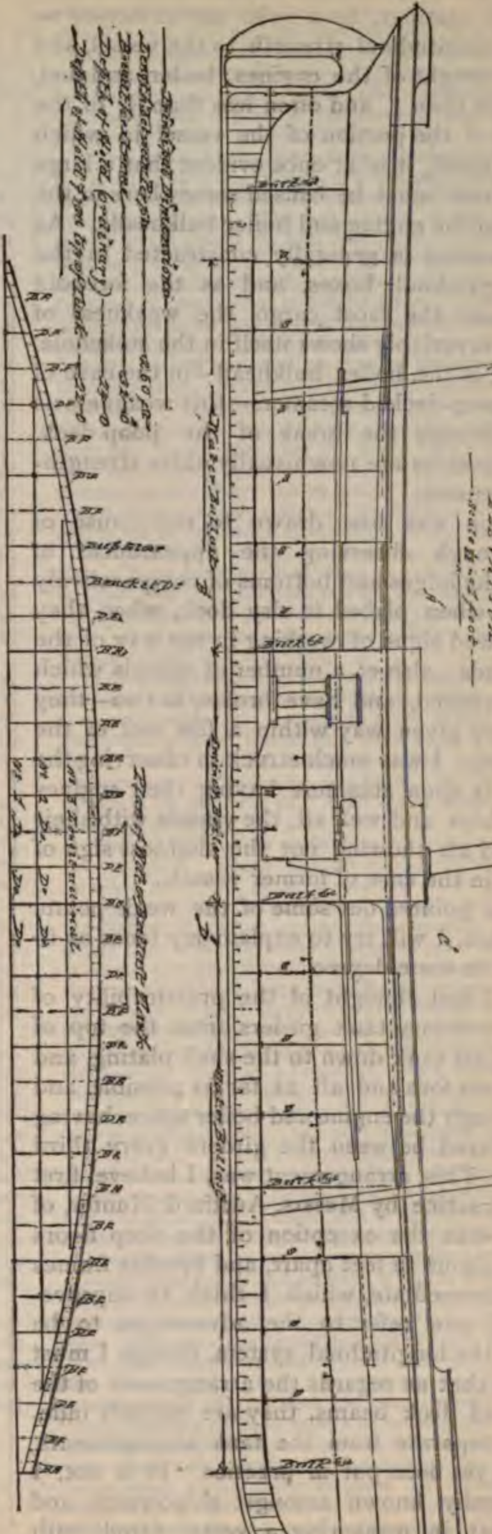
CONSTRUCTION OF IRON STEAMERS ON M. W. AISBITT'S LONGITUDINAL OR DEEP FLOOR SYSTEM.

It will be easily conceded, I think, by all practical men, that the great desideratum in iron shipbuilding is to obtain the greatest amount of strength with the least weight of iron, and, at the same time, to have sufficient local rigidy to prevent buckling or bulging. About 14 years ago, when iron steamers were beginning to attract attention as general heavy cargo carriers, the principal feature that one observed in their construction was the great amount of transverse as compared to longitudinal strength, the beams, floors, frames, and reverse frames being much in excess of present requirements, while the stringers, keelsons, and some of the shell plating were all considerably lighter than as now fitted. This error of construction was soon detected; when vessels of great length, with full cargoes, were sent across the Atlantic, by the butts of the shell, bilge, and stringer plates showing signs of weakness, and the vessel usually had to be strengthened on her arrival home. It was to Liverpool that we were indebted for making the first advance in an improved method of construction through the formation of the Liverpool Underwriters' Association, who, with the assistance of private shipowners and shipbuilders, formed their rules for the scantlings of iron vessels, to meet the new requirements. The changes which those gentlemen inaugurated consisted in considerably increasing the width of the stringer plates, the thickness of the shell and bilge plates, and the dimensions of the keelson and stringer angle irons, while, at the same time, reducing the dimension of the beams, floors, and frames. The wisdom of this course was soon perceived, and was gradually taken up by others. Amongst other improvements which were made, I believe Messrs. Holt, of Liverpool, were the first to introduce iron decks, which have since been so much in favor.

When the practice of fitting water ballast tanks came into fashion, many kinds were adopted, which gradually resolved themselves into the present system of supporting the tank top by girders carried longitudinally on top of the floors: this, through a great improvement in the construction of the tank, was also a cause of great weakness to the strength of the vessel, where the engines were placed amidships, as according to Lloyd's rules (to which the majority of vessels are built). The same number of keelsons and stringers were fitted, whether the vessel had a tank or not; the builder not being compelled to carry the girders through the engine and boiler room, stopped them at the two bulkheads, the ordinary


Elevation of No 4 Long^l
View of Upper Side
Plate Knee
Plate Knee
Knee frames Single Angle Iron, Intermediate frames doubled with Aft pieces
Elevation of No 2 & 3 Long^l
Inside View
deep floor
Bracket
deep floor
Elevation of No 1 (Center) Long^l
A' Aft doubling pieces across Center
A
A
A
Deep Floor
Bracket
Deep Floor
B' Frames doubled at Center with Aft pieces
MIDSHIP SECTION
through A B & C D
Angle Iron Beams on every frame
Frames spaced 24 in apart
Deep Floors spaced 12 ft apart
Bracket floors spaced intermediate
12 in Longitudinal plate
Do on Upper Deck
Doubling piece
Plate Knee on Deep floors & Bracket frames
No 1
No 2
No 3
No 4
Doubling Piece

Details and Sections. Scale ⅛-in. to Foot.


Principal Dimensions
Length between Perp.
Breadth Extreme
Depth of Hold (ordinary)
Depth of Hold from top of Floor
Deep Floor
Bracket Do
Water Ballast
Coal Bunker
Plan of Water Ballast Tank
Water Ballast
Bracket
ELEVATION
Scale ⅛ in to foot

—PLAN OF LONGITUDINAL AND DEEP FLOOR SYSTEM.—

tonnage of the steam cranes is constantly rising. The crane we illustrate is the manufacture of Messrs. Ransomes & Rapier, and is constructed for a load of 25 tons especially for the Australian Goverment.

For convenience of movement, the whole superstructure of the crane and its bearing plate is [illegible] on a wrought iron truck which has 8 cast steel [illegible] so that the superincumbent load, which [illegible] is distributed over a considerable area [illegible] This load will be increased by the [illegible] lifted, whatever that may be.

Wrought iron rivetted work is [illegible]
structure, except in a strong [illegible]
with inner roller path. The [illegible]
iron roller path, 16ft. in [illegible]
has a wrought iron [illegible]
and each of these [illegible]
on the larger [illegible] cause of
steady, as the [illegible] ances of
frame over th[illegible] comparatively

The jib i[illegible] when they
plates fr[illegible] the way of the
to 30ft., [illegible] vessels which
[illegible] broken in two—they

The [illegible] a few feet of the
plat[illegible] struck in observing the
the [illegible] having their engines
[illegible] the vessels with their
[illegible] not the slightest sign of
[illegible] former vessels.

[illegible] some of the weak points [illegible] will try to explain my ideas as to [illegible] degree.

[illegible] thought of the practicability of [illegible] tank girders from the top of [illegible] tank down to the shell plating, and [illegible] fore and aft as far as possible, and through the engine and boiler space, having [illegible] fitted between the girders every third [illegible] This arrangement was, I believe, first [illegible] into practice by Messrs. Austin & Hunter, of [illegible] with the exception of the deep floors [illegible] placed about 12 feet apart, and bracket frames [illegible] intermediate, which I think an improvement. I will now refer to the advantages to be [illegible] from the longitudinal system, though I must [illegible] mention, that as regards the arrangement of the stanchions and deck beams, they are entirely independent and separate from the tank arrangements, and have not yet been put in practice. It is not, I believe, generally known amongst shipowners and engineers, that in measuring a vessel fitted with water ballast tanks, for nett and gross tonnage, the Board of Trade always measure from the top of the floors, irrespective of the height of the tank above the floors; *and consequently* that the shipowner pays [illegible] space which is never occupied by [illegible] obviated in my system, as the deep [illegible] to the tank top, and thus makes a [illegible] the shipowner of from 90 to 100 tons [illegible] in a vessel of 1,500 tons gross register, [illegible] nett. The vessel is also two feet less depth [illegible] than by the old method of measuring to top [illegible] floors. As regards the shipbuilder, he would gain [illegible] advantage of about 15 tons of iron, and also save a considerable amount of time in getting the frames into position ready for fitting the plating, on account of having no floors or reverse frames to fit on the boards. The amount of labour I think will be less when once the workmen get accustomed to the system.

And now having explained that portion of my system which has been carried out in practice, and which is gradually gaining favour, I will attempt to explain my ideas as regards the hold stanchions and deck beams.

To exemplify what I consider the evils of the present system of fitting the stanchions and hatches, we will take two sample vessels—the one an ordinary Atlantic cargo or three-deck steamer, the other an ordinary break-decked collier, having long trimming hatches. In the first vessel we have generally a fore, main, and after-hatch, with combings about 24 to 30 inches deep, the main and after hatches being usually 18 to 22 feet in length, and 11 to 12 feet in width. Between those two hatches is generally fitted an iron deck-house, containing the galley and entrance to the stoke-hole and engine room. Between those hatches and this engine casing the beams are entirely independent of each other, and if through weight of cargo, a sea striking the deck, or the vessel straining, one particular beam gives way, it has little or no support from its neighbour. Again, when the vessel receives a longitudinal strain, each beam will be of little or no assistance to the bottom keelsons and girders. My idea is to avail ourselves of the great strength in the hatch combings and engine casings, by connecting them together by a vertical plate, say 12 inches deep and ½ thick. This would then form two upper girders, carried over the midship portion of the vessel, and with the stanchions well secured to them and the lower longitudinals, would form a complete girder.

In respect to the second vessel, it is even more important, and would cost less, to connect the long main hatch combings and the engine casing together, as it is very common to see a long hatch 20 to 30 feet in length, and standing 3 feet 6 inches high, stopped off within 3 feet of the break-deck.

Doubtless my ideas will not secure the approval of all, and may in some respects have to be modified; but though they are the results of several years' reflection, I am always open to correction, and shall be glad to have any faults pointed out.

THE MANUFACTURE OF LARGE FORGINGS AND THE MATERIALS SUITABLE FOR THE SAME.

PAPER READ BEFORE THE IRON AND STEEL INSTITUTE AT LIVERPOOL, BY G. RATLIFFE, MERSEY STEEL AND IRON WORKS, LIVERPOOL.

(Continued from page 144.)

ore it might perhaps be asked, how and by whom were afts originally made? This question is easily answered, uld be unjust and ungenerous for me to give any such and you must please accept the tests before you, of only give you the figures, but show you in addition s of each as they actually appeared after being tested. pieces of steel are taken from shafts varying in size, the smallest of which was 15in, in diameter. Two of them are from crank-shafts, and the other from a straight shaft. It is important we should bear in mind that, as these pieces of steel shafts have been heated and drawn down to the sizes required for the experiments, they are considerably improved both in their bending and twisting qualities. On the other hand, the welded pieces have been piled together in the usual manner, twice heated in the ball-furnace, and afterwards drawn down at a forge hammer; so that if those pieces had been made into a forging they would have received a greater amount of work, and would have been more ductile than they are now. This, however, I consider satisfactory, seeing that with all this for and against, the results are directly opposite.

For almost all descriptions of forgings the materials should be of a very ductile and uniform nature, and it was with this idea before me that I endeavoured to procure a material combining these qualities most suitable for forgings.

In each case the pieces tested for tensile strength, twisting, bending, and also for showing the fractures, are taken from one piece of metal. Two tests of each have been made as the fairest way to arrive at a satisfactory conclusion; for, as you will notice, although they are fairly uniform, yet there is some difference.

The manner in which these samples have been tested is as follows: First, the pieces to be tested for tensile strength were all drawn down to 1¼in. in diameter, and 8in. of their length turned down to 1in. in diameter. Mr. Adamson very kindly volunteered to test these pieces for me, and I have to thank him for the assistance he has thus given me.

For the twisting tests the pieces were drawn down to 2¼in. square, then turned by 1 19/32in. in diameter (equal to 2 square inches area) for a length of 2ft. fastened in the lathe by the dog chuck, and firmly secured at the other end; precautions being taken to allow for the contraction while twisting. The lathe was then turned slowly round.

For the bending tests the pieces were drawn down to 2¼in. square to 2ft. 4in. long, and planed down to 2in. square. Two strong brackets were made and bolted to a surface plate fixed 20in. apart centre to centre; a large steelyard was then attached with an eye-bolt, shackle and weights added to the steelyard as required. It was found rather inconvenient to get the deflections. This has been in all cases taken by a 12-in. straight edge. Had they been taken from the centres of supports they would have been so much greater. However, as all the pieces have been treated exactly alike, the comparison is not affected. As these pieces began to bend more rapidly, the pressure was continued in all cases in which the metal would allow of it before breaking, until the two ends came parallel.

Owing to the suspension of our general steel trade, for the present we have dispensed with a chemist at the works, so that it is not possible to give you an analysis of each sample, but as it was necessary to get an analysis of the welded steel before using it, that steel has been analysed by Mr. Edward Riley, of London, the result being as follows:

Carbon	·173
Silicum	·140
Sulphur	·100
Phosphorous	·070
Iron	98·925
Manganese	·228
Copper	Nil
	100·336

In order to make sure of the uniform quality of the steel being used, a small piece is taken from each cast about 1¼ in. square, and worked down in the smithy to about ¾ in. square, cut in two welded, and bent cold across the weld. This test is a most valuable one, as it and the chemical test have in all cases agreed with one another. By some it is supposed that in the Bessemer process the greatest difficulty is to obtain uniformity of quality; but this is not so, as in 35 casts, when endeavouring to get ·15 per cent. of carbon, a mean of ·161 per cent. was obtained, the lowest percentage being ·146 and the highest ·186.

Samples No. 1 were made from shearings of ship-plates. This metal all came from one yard, and was good, clean ship-yard scrap, so that it was a more uniform scrap than would be obtained in every-day practice. The appearance of the fracture from the tensile strain was in the first case highly crystalline, with a small fibrous portion in the centre; in the second case dark grey and crystalline, and that of the sudden fracture a coarse grain. In twisting, it commenced to exhibit a rough appearance almost as soon as the lathe was started, and in both instances broke with a very loud report. The fractures were irregular, and of a crystalline nature. When bending, it stood far better than might have been expected. In one case the weight shown in the Table was increased by 1 ton, and in the other by 2 tons. The pieces bent slowly, and as the weights were gradually removed the bending went on. In the first case the piece broke suddenly when the ends were 11⅜ in. apart, and in breaking gave a loud report. The fracture shows a very coarse grain. The other piece broke when the ends were 13½ in. apart. The fracture shows a coarse grain, and is not at the centre of the bend. It also made a loud report.

Samples No. 2 were made from the best selected scrap iron, that is, from such pieces of scrap as horse-shoes, old bolts, rivets, and bar iron that had been worked into finished merchant iron. The appearance of the fracture from the tensile strain was dark grey, very crystalline, with large crystals; and that of the sudden fracture a fair ordinary iron.

In twisting, these samples have the appearance of an irregular fracture, and they parted without any noise. When bending, 2 tons were added to the weight given in the Table, and the iron bent rapidly until fractured. One piece resisted the bending much better than the other, as shown by the samples. The fracture was not attend by any noise. At the time of breaking, the ends in the first case were 13½ in. apart, and in the second case 11¾ in. apart.

Samples No. 3 were made from old marine boiler plates of very good quality. There was no stamp visible on them. These samples have one great advantage—they are made from the shearings of one plate, and as this would not be practicable in the making of a large forging, these results may be considered better than would be found in general practice. It is quite clear however, that this material is far better and more suitable for the manufacture of large forgings than either of the others. The appearance of the fracture from the tensile strain was dark grey, slightly crystalline, and that of the sudden fracture a rather coarse grain. In twisting, it had the appearance of having been sheared off. One piece broke off with a considerable report, and the ends flew some yards. The other made no report. When bending, the weight given in the table was increased by 1 ton. The iron bent rapidly, and as it continued to bend the weight was reduced. In one case the piece bent until the two ends were parallel with each other; and when the weight was altogether removed, it sprang back ⅝in. In the other case I noticed a very small fracture on one edge, and it almost instantly broke with a moderate report. This fracture showed a fine grain.

Samples No. 4 were made from puddled iron, prepared at the Mersey Steel and Iron Company's Works from pure all-mine pig iron, with a considerable proportion of cold blasting iron, and after receiving the necessary workings, were drawn down for the test bars. The appearance of the fracture from the tensile test was dark grey, slightly crystalline, and that of the sudden fracture a fine, close, regular grain. In twisting, they showed less signs of bursting than the previous samples, twisted considerably more, and ultimately sheared square off noiselessly. When bending, the tabulated weight was in both cases increased by 2 tons. They bent very slowly, and afterwards the weight was reduced by 3 tons, upon which the bending stopped. It re-commenced, however, when 2 tons were added, and then the weights were gradually removed until the two ends were parallell with each other. The weight was then altogether removed, and the ends opened in one case ½ in., and in the other ⅜ in. There is no fracture whatever to be seen, and the iron has retained a smooth and regular surface

TABLE SHOWING TESTS OF EXAMPLES EXHIBITED.

	SIZE OF SPECIMEN.			TENSILE TEST.					TWISTING TEST.		BENDING TEST.				
	Diameter.	Area.	Fractured Area.	Permanent Set Induced per Square Inch.	Maximum Strain per Square Inch.	Per Cent. of Elongation when Maximum Strain is applied.	Final Breaking Strain on Original Area per Square Inch.	Per Cent. of Elongation.	Showed Signs of Splitting at turns.	Twisting off at Turns.	Deflected with 20,000 lb.	Deflected with 26,000 lb.	Deflected with 38,300 lb.	Deflected with 42,000 lb.	Material.
				In Tons.	In Tons.		In Tons.								
	in.								in.	in.	in.	in.	in.	in.	
1A	1	.7854	.502	15.34	26.14	24.0	24.43	25.0	⅜	2¼	⅛	...	...	...	Iron
B	1	.7854	.477	14.77	25.85	23.0	23.01	27.0	⅜ nearly	2⅜	¾ full	...	...	...	"
2A	1	.7854	.477	14.77	25.00	21.0	23.30	23.0	½	3¼	11/16	...	...	...	"
B	1	.7854	.594	13.35	25.00	22.0	25.00	22.0	⅝	4⅛	15/16	...	...	...	"
3A	1	.7854	.465	13.07	24.43	22.5	21.31	26.0	¾	4¼	1⅛	...	...	...	"
B	1	.7854	.430	15.62	24.72	24 0	21.87	32.0	⅝	4½	1 5/16	...	...	...	"
4A	1	.7854	.477	14.49	30.40	24.0	22.45	23.0	1½	6¼	1 3/32	...	...	...	"
B	1	.7854	.453	14.77	24.72	23.0	22.45	26.0	2¾	5⅝	1⅛	...	...	...	"
5A	1	.7854	.688	30.12	59.11	8.0	59.11	8.0	...	¾	...	...	..	⅜	Steel
B	1	.7854	.692	30.12	59.11	8.0	59.11	8.0	...	1	...	...	...	7/16	"
6A	1	.7854	.673	19.93	42.91	12.0	42.91	12.0	...	⅜	...	...	2	...	"
B	1	.7854	.753	19.60	39 78	5.0	39.78	5.0	...	2½	...	...	2⅛	...	"
7A	1	.7854	.676	30.97	59.96	9.0	58.54	9.0	...	1⅝	...	...	...	¾	"
B	1	.7854	.704	22.12	59.39	7.0	59.39	7.0	...	1	...	...	...	11/16	"
8A	1	.7854	.453	18.47	30.97	18.0	28.79	25.0	2	5½	...	1 7/16	...	...	"
B	1	.7854	.483	18.18	31.54	18.0	28.70	26.0	5½	5⅜	...	1⅝	...	...	"

Samples No. 5 were cut off the end of a steel crankshaft 19½ in. in diameter, heated and drawn down to the required size. The appearance of the fracture from the tensile strain was in the first case fine bright crystalline, and in the second fracture, fine bright crystalline, with dark flaw at centre; and that of the sudden fracture a fine grain with the appearance of very tough and strong metal. In twisting they broke off very suddenly with an exceedingly loud report, and the pieces flew across the shop. The fractures of this metal were very irregular, but uniform in grain. When bending, 1 ton was added to the tabulated weight in the first case, and it broke very suddenly; in the second case (although off the same bar) 4 tons were added, and it then broke very suddenly. The appearance of the fractures in both cases was that of a good, tough, strong steel.

Samples No. 6 were from a steel straight shaft 19 in. in diameter a piece being cut off the end as before, and hammered down to the required size. The appearance of the fracture from the tensile strain was fine bright crystalline, and that of the sudden fracture a very fine-grained steel. In twisting, one piece broke suddenly and made a moderate report, and the fracture was of an irregular nature. The other piece was twisted two and a half times, and sheared straight off, comparatively noiselessly. When bending, the tabulated weight was increased by one ton, and the pieces bent very rapidly, and broke suddenly with a loud report.

Samples No. 7 were taken off the end of a crankshaft 15 in. in diameter, and drawn down under a steam hammer to the required size. The appearance of the fracture from the tensile strain was in the first case bright crystalline with dark flaw, in the second case bright crystalline, and that of the sudden fracture a good, tough, steely nature. In twisting, both pieces broke with a loud report, and flew a few yards. The fractures were very irregular in form and grain. When bending, 5 tons were added to the tabulated weight in the first case, and after this load had been on some considerable time I closely examined the piece, which showed no signs of fracture; but almost immediately after it broke with a loud and startling report. The other piece was then tried, and the weight increased in the same manner, and this great weight remained on the piece for more than an hour without any sign of giving.

Samples No. 8 were made from Bessemer steel ingots of mild nature, rolled down into small bars, cut up, crossed, piled, and welded together as in ordinary iron, without any flux whatever. The appearance of the fracture of this material from the tensile test is velvety, and that of the sudden fracture a fine steely grain. In twisting, both pieces show a very regular appearance, and have twisted off as if they had been sheared without the least report whatever. When bending, the tabulated weight was in each case increased by 2 tons, and the pieces bent slowly. By degrees 3 tons were taken off. The pieces were ultimately closed, so that the ends came parallel with one another. When the load was removed the ends opened out, in one instance ¼ in. and in the other ⅝ in. Neither piece exhibited any sign of fracture, and the outer surfaces still show a smooth skin.

Samples Nos. 9, 10, 11, and 12, were some of the first pieces made of this material; and in order to prove whether the welding was sound, a piece 3½ in. in diameter was taken to a 5-ton steam hammer, and knocked backwards and forwards so as to open it if possible; but with the twenty-ninth blow it broke, showing no sign whatever of any welds.

Piece No. 12 was then drawn down to 2 in. square, and deflected backwards and forwards under a rail straightening press about ¼ in. each time for 105 years. The following morning it was nicked and broken, and, as you see, it is quite sound.

The analysis of the bar (No. 9) before welding was as follows:

Carbon	·153
Silicum	·026
Sulphur	·152
Phosphorous	·089
Iron	98·798
Manganese	·785
Copper	Nil
	100·003

Borings taken from the 3½ in. bar (No. 10) give ·139 per cent. of carbon, and those from the smaller piece, 1½ in. in diameter (No. 11) ·134 per cent. These results show that the carbon is gradually reduced by the various heatings.

In looking over the Board of Trade Report on Railway Accidents, it is noticeable, with reference to the failures of broken axles, that "of the thirty-six crank or driving axles, twenty-four were made of iron and twelve of steel. The average mileage of twenty-one iron axles was 193,999 miles, and of ten steel axles, 188,472 miles." As there must be a very great many more iron axles running at the present time than there are of steel, the above figures do not speak very much in favour of steel for this use; but if the steel axles had been made of a quality of steel that would weld, the failures would probably have been less, and very considerably less if the steel had been worked and welded as these samples (No. 8) have been before you.

Now, considering that shafts are frequently subjected to sudden and severe strains, in many cases severe beyond calculation, it is evidently advisable to have them made of a ductile material. From the foregoing it will be seen, first dealing with the iron, that forgings made from the shearings of ship plates or (to use, perhaps, a better term) shipyard scrap, although they may turn up very clean, do not possess the requisite ductility.

The best selected scrap is, to say the least of it, uncertain; and owing to the varying qualities of iron we are so liable to get, we cannot insure a material of uniform quality, but often find seams or black marks, which are by so many engineers considered sufficient to condemn almost any finished shafting.

The good boiler plate scrap, which in the case before you consisted of old marine boiler plates ⅝ in. thick, sheared up into small pieces (in each of these cases the scrap iron was scoured in order to free it from dirt or scale), shows itself a very much better material for such purposes. The new iron made from the all-mine and cold-blast pigs, carefully worked and piled, produces a still better material. The steel samples need but little comment, as the first of them are all taken from shafts that have been at work, but I think these few tests show sufficient to prove that the materials most suitable for large forgings are not scrap iron or irons and steels of a high tensile strength, but those of a softer nature and more uniform quality.

Let it not be understood that I am asserting that all the steel shafts made at the present day are of such hard materials as those illustrated, for it is probable but very few manufacturers (if any) are now making such material, especially for shafting. It is my opinion, however, that forgings, with but very few exceptions, to give the engineers most satisfaction, should be made from the softer materials. It is probable that ultimately most of the large forgings will be manufactured from a metal made by the Bessemer converter or by the open-hearth furnace, of a mild nature and capable of being welded together, as in samples No. 8, which I have shown you, because the welded material will facilitate the manufacture of complicated forgings, of which, in shipbuilding, there are many required. The cost, too, of making forgings of such steel is considerably less than that of making them for large ingots, and we have the further advantage of making sure that all the particles or molecules are properly worked.

It was my intention to have had a double-throw crank-shaft at the works, made from this welded steel, to show you in the finished state; but I am sorry to say that the gentlemen for whom it was made telegraphed orders for it to be sent off to the vessel. I have, however, a small sample out of the scrap, machined bright and bent cold.

Now that we are talking about the manufacture of large forgings, I cannot resist referring to armour plates and guns. I believe welded steel to be a most suitable material for armour plates, but as yet have not had opportunities for testing it. For guns, however, sample No. 13 has been made from steel bars welded into a billet, rolled down into a bar 1¼in. square, made into a coil and welded, turned and bored to 3⅝in. inside diameter and 4½in. outside diameter by 9in. long. Both ends have been plugged with screw plugs, and a charge of Curtis and Harvey's best gunpowder exploded inside it. I expected that a charge of two ounces would have bulged or burst it, but this had no effect. A charge of four ounces was next tried, and it made a loud report, but did no damage. Afterwards eight ounces were placed inside the piece, and the explosion blew out the end, but appeared not to have, in any perceptible manner, affected the general form of the cylinder.

Another piece of the welded steel was afterwards taken (without being coiled), a hole ¾in. in diameter bored through it turned to 1¼in., outside diameter, and secured at each end by two cap nuts. A charge of 480 grains of gunpowder was then exploded within it. and it expanded in the centre to $2\frac{15}{16}$ diameter, splitting into three pieces.

A third piece of the same material was prepared in a similar manner to the preceding, and charged with 270 grains of gunpowder. This having no effect, charges of 200, 300, and 320 grains respectively were tried, and the latter caused the piece to expand about $\frac{1}{64}$in, and exhibit signs of a very fine line on one side Two more charges of the same weight as the last having been exploded, one of 330 grains was put in, after which the crack was more visible, and the piece bulged. With 340 grains the crack extended for nearly half the length of the piece, and was bulged about ⅛in. A charge of 350 grains (which nearly filled the bore) was next put in, and the explosion caused the piece to burst into eight pieces.

It was not expected that the samples taken from a straight bar would have stood such severe tests; but had all the samples been made from coils the metal would have resisted a far greater pressure or explosive force. May it not be inferred that the experiments prove conclusively that this material is most suitable for such purposes as heavy ordnance? And I am of opinion that it will ultimately be largely used for such like purposes.

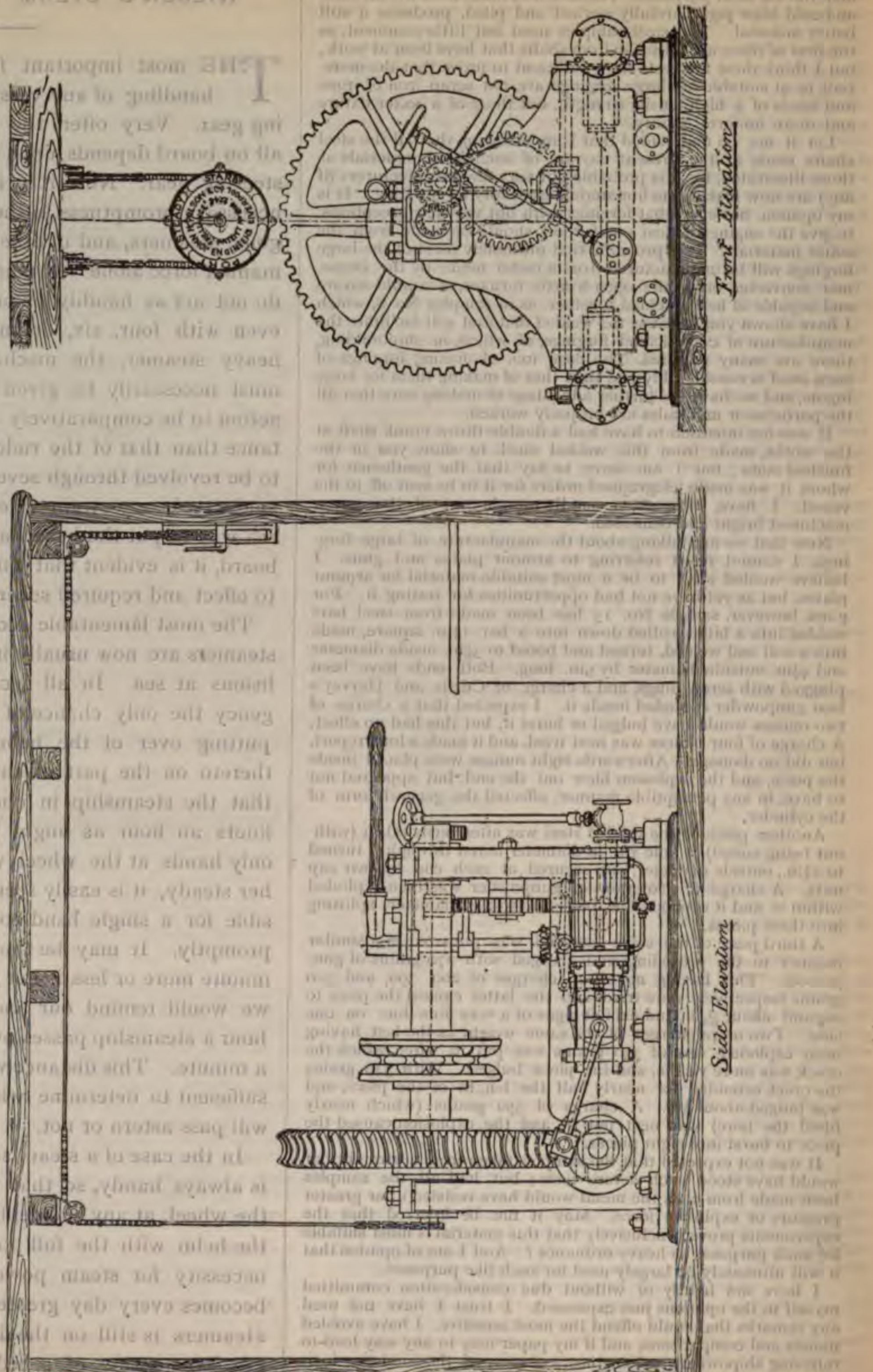
I have not lightly or without due consideration committed myself to the opinions just expressed. I trust I have not used any remarks that could offend the most sensitive. I have avoided names and comparisons, and if my paper may in any way lead to relieving shipowners and engineers of some of the anxieties incident to their occupations, I shall feel that I have not treated this subject in vain.

WILSON'S STEAM STEERING GEAR.

THE most important feature in the successful handling of any vessel is certainly the steering gear. Very often the safety of the vessel and all on board depends upon the prompt action of the steering gear. Now it is not easy to obtain these necessary promptness in the case of our large ocean going steamers, and in other vessels of equal size by manual force alone. A number of men at the wheel do not act as handily or promptly as a single man, even with four, six, or more men at a wheel in a heavy steamer, the mechanical advantage which must necessarily be given to the wheel causes its action to be comparatively over a much greater distance than that of the rudder If then a wheel has to be revolved through several complete revolutions against a heavy strain when going at speed, or in a sea way to put the helm hard a-port, or hard a-starboard, it is evident that this will require some time to effect and required several hands to do it.

The most lamentable accidents to heavy sea-going steamers are now usually in form of unexpected collisions at sea. In all such cases of sudden emergency the only chance of escape will be a prompt putting over of the helm, and immediate answer thereto on the part of the vessel. But supposing that the steamship in question, running free at 15 knots an hour as might be the case, and that the only hands at the wheel was a single man to keep her steady, it is easily seen that it would be impossible for a single hand to put the helm over very promptly. It may be thought that a quarter of a minute more or less is not of much consequence, but we would remind our readers that at 15 knots an hour a steamship passes over 380 feet in a quarter of a minute. This distance will evidently be more than sufficient to determine whether the colliding vessel will pass astern or not.

In the case of a steam steering gear the full power is always handy, so that the one hand in charge of the wheel, at any moment, can, unassisted, put over the helm with the full power of the engine. This necessity for steam power as applied to steering becomes every day greater, as the size of sea going steamers is still on the increase, together with increased powers of speed. Many steamships are already so supplied, and the application of such gear to others will be only a matter of time.


STARB'D
STEADY
PORT
Front Elevation
Side Elevation

STEAM STEERING GEAR

The gear we illustrate has several unique and valuable features, and is the invention and the manufacture of Messrs. John A. Wilson & Co., of Liverpool, who have already applied it to several vessels, amongst others the S.S. "Speke Hall," "Rydall Hall," &c., and are now very busy executing further orders for it.

Its distinct character consists in the arrangement by which the operator or man in charge apparently only works an ordinary yacht tiller, offering no resistence to his manipulations, and the rudder instantaneously following the action of this tiller, as if operated direct from it. This arrangement is effected by making the tiller operate bevil gear on a rocking shaft or weigh bar, this weigh bar carrying the valve blocks in the reversing limbs of the two horizontal engines, which are used to put over the rudder. The two engines drive a worm pinion and shaft, which gears into a worm wheel on the chain drum shaft with a mechanical advantage of 64 to 1. A chain barrel is keyed on to this shaft and over which are led the rudder chains. All strain on the rudder from the high speed of the vessel or from a rough sea, is thus taken on the worm gearing, which practically locks the rudder. As the engines are coupled at right angle on the worm pinion shaft, they will start to work with certainty at any moment.

When the order is given to "port the helm," the tiller handle is put over as if operating the rudder direct for that purpose. Should the next order be "steady" the tiller is drawn over to starboard, till the tell-tale shows that the rudder is amidships when the tiller is also brought amidships, and held there ready for the next order. The stopping or over-running gear is a novel feature in this apparatus. To prevent the rudder from being jammed against the stern post when part "hard over," a slotted quadrant or rack acts on a lever in direct communication with the starting gear. Should the tiller then be say "hard-a-port," the rack brings the tiller to its centre and stops the engine to where ever it may be set.

The advantages claimed for this gear are simplicity and moderate cost, economy of steam, and prevention of sudden strain on the steering chain; and, finally, accuracy and promptness of steering. With full steam on the engines will run at a high speed, and the helm can be put over in a few seconds. If required, the cylinders can be made of sufficient size and power to put the helm over when going at full speed; but it is found in practice that the rudder head and parts must be made of special strength to stand such a strain. We should ourselves consider that a vessel should be fitted with steering apparatus and rudder gear strong enough to effect prompt steering at full speed, though no doubt in practice speed is better reduced where fine steering has to be done.

This gear can be worked from the bridge forward, whilst the gear itself is placed aft; and hand gear is easily combined with the steam gear should it be required, which we should consider advisable.

THE POSITION OF NAVAL ENGINEERS. The hopes of naval engineer officers have been recently revived by the appointment of Admiral Sir Cooper Key, as Senior Sea Lord, and the enquiries which have been subsequently set on foot as to the manner of counting time for promotion. The fact has also been hailed with satisfaction that in the new edition of the Queen's Regulations and Admiralty Instructions the duties and responsibilities of the engineer officers are for the first time clearly defined. It is ordered that the engineer officer is to have charge of and be responsible for the efficiency of the machinery and boilers of the ships and boats, all auxiliary engines for whatever purpose fitted, all pumps connected with bilges and double bottoms, and everything belonging to them, distilling apparatus, iron gun-carriages, screw-lifting apparatus, turret engines and gear, hydraulic machinery and gear for guns and turrets, ventilating, steering, and capstan engines and gear, hydraulic jacks, winches for hoisting projectiles, watertight doors, sluices, and valves, including horizontal trap and flap doors, and vertical hinged doors between decks, engineroom fire extinguishing apparatus, instruments for telegraphing signals, Whitehead torpedoes and submerged discharging tubes and gear, and such other parts of the hull and double bottoms as are in his charge wholly or jointly with other officers. Being charged with such onerous duties, the engineers are naturally asking for a commensurate improvement in their pay and position ? and taking into consideration the fact that when the report of Sir A, C. Key's Committee was before Parliament, the then First Lord (Mr. Ward Hunt) gave the House to understand that the portions of the report then adopted were only to be considered as an instalment of the debt that was due, the officers have asked that the recommendations of the committee may be completely carried out, with two modifications, the one referring to the retirement of engineers, and the other to the method of counting junior time. The existing regulations on the latter subject bear with exceptional severity on the engineering branch. The Admiralty have already allowed engineers of eight years' seniority to rank with, but after, lieutenants, and have granted a widow's pension corresponding to the higher rank; and the officers now ask that their position may be further assimilated by their being permitted to count senior service from the date of their obtaining lieutenant's rank.—*Times.*

AMERICAN STEAM SHIPBUILDING. The steamer City of Alexandria, recently launched by Mr, J. Roach from his shipyard on the banks of the Delaware, has arrived at New York to take her place on the Alexandria Line to Havana and Mexico. The City of Alexandria is 333 ft. long over all, 38.6 ft. beam, 25 ft. deep from main deck, 33 ft. deep from hurricane deck. Her iron plates are from 1 in. to ⅝ in. thick. The spar deck is iron. Annexed are other details of the ship: Compound engine: high-pressure cylinder, 42½ in.; low pressure, 78 in.; stroke, 54 in; carries 80 lb. steam; has four boilers, 10 ft. long, 14.6 ft. diameter, grate surface, 345 ft.; Hersch wheel, 16.3 ft. diameter, 25 ft. pitch. She has steam reversing gear, which enables her to reverse immediately, even at full speed, without shutting off steam; also a patent marine governor; steam launch; five water-tight compartments; Pullman car berths; and patent sea-sick berths.

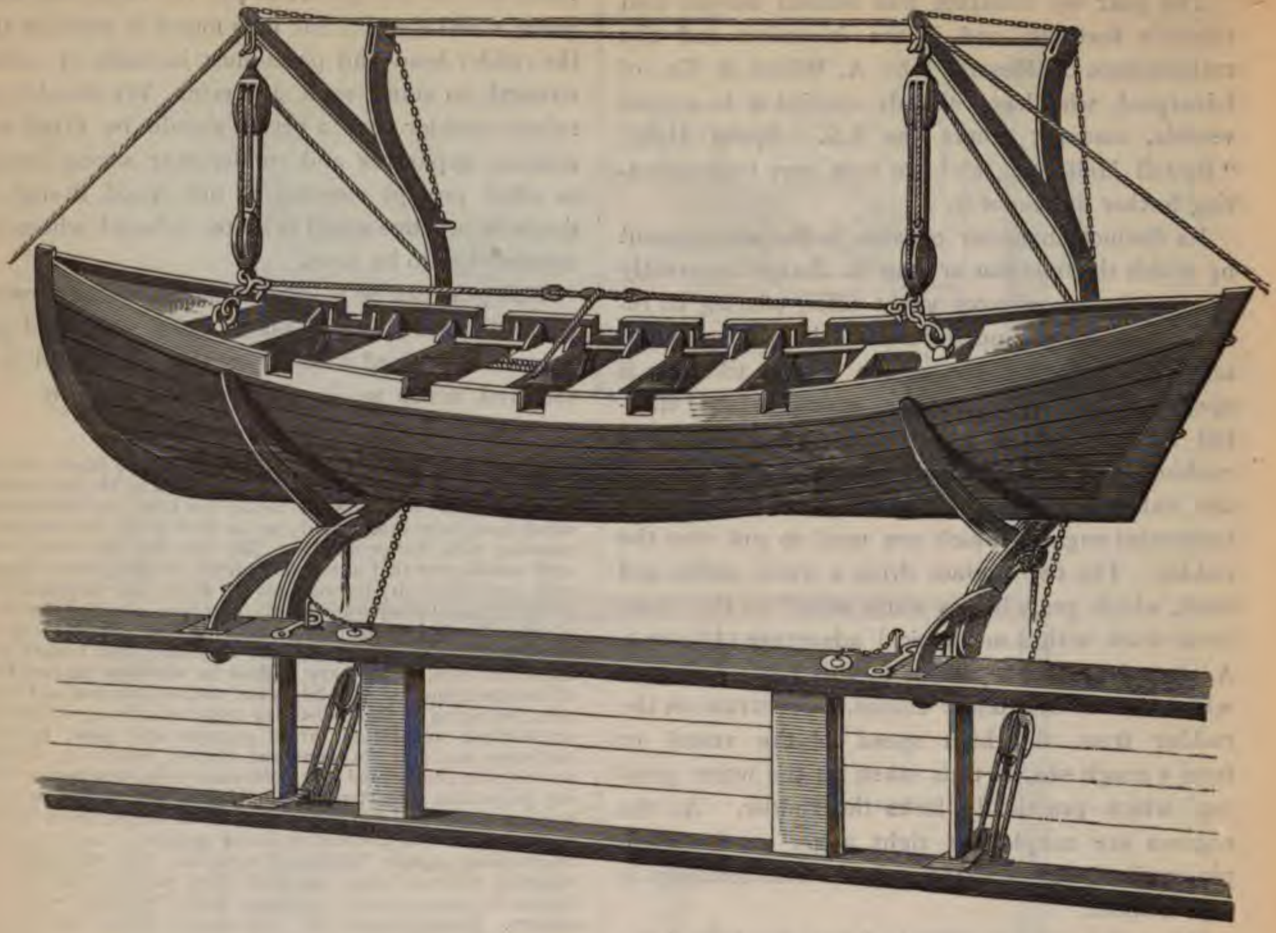


Fig. 1.

BARRY'S PATENT DAVIT.

The importance of a ready means for lowering out the boats upon all classes of sea, channel, and river-going vessels, cannot be too highly estimated. We are being constantly brought face to face in the newspaper reports with deplorable accidents and loss of life, resulting from the want of efficiency in the boat-lowering apparatus.

In one case it is a sudden collision, either in the river or at sea, and one vessel foundering immediately, crowded with a helpless living freight The sudden shock and confusion are sufficient to render the lowering gear—which at the best requires care, time, and great tact in handling—at such a moment perfectly unmanageable, and the result is a deplorable loss of life, often within sight and easy reach of the shore or of a succouring vessel.

In another case it is a sailor who falls overboard from an ocean steamer with full way on her. Before she can be rounded to, or a boat lowered, the strongest swimmer may have sunk for ever. Or even at our very doors, in the Thames, should a man wilfully or by accident fall into the rapid flowing stream or tide, there are few means of lowering a boat sufficiently promptly at hand to render effective assistance.

We illustrate, however, in this issue, an improved Davit and Releasing Gear, the former the invention of Lieutenant Barry (R.N.R.), and the latter that, we believe, of Messrs. Hill & Clark. This gear promises fair to give an immensely superior method of lowering out a boat at a moment's notice, and we hope that no shipowner, and more particularly no line of sea-going passenger steamers, will be so blind to the interest and safety of their human freight as to delay for an instant in applying any such greatly

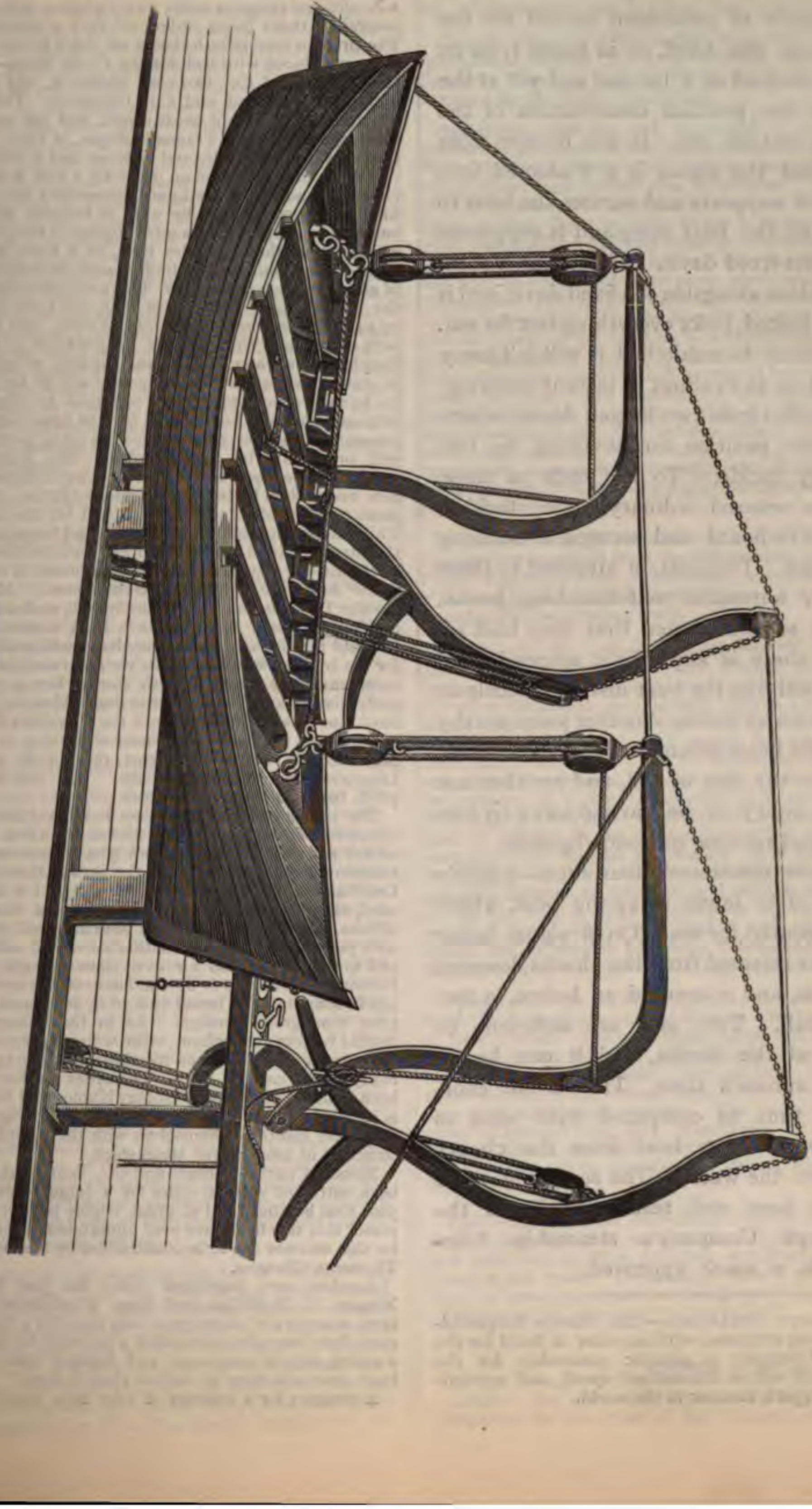


Fig. 2.

improved method, when its practical value shall have been successfully proved.

An important trial of this apparatus was very successfully carried out a short time since in the presence of a number of gentlemen invited for the purpose. The boat was fixed, as in figure 1, on its chocks, perfectly secured as if for sea, and yet at the same time, from the peculiar construction of the davits, ready for instant use. It will be seen from the illustration that the chock is a V-shaped iron arm, one of which supports and secures the boat to seaward. In board the boat rests and is supported on the hollow of the fixed davit. The other V arm of the chock lies close alongside the fixed davit, and is there secured and bolted, to fix everything fast for sea. As soon as this chock is unhitched it will fall away free from the boat, so as to admit of instant lowering. The boat is suspended from two hinged davits, which are hauled up into position for chocking by two chains and pulley tackle. To the ends of these hinged davits are secured ordinary pulley tackles, the falls being run in-board and secured to belaying pins on these davits. The boat is attached to these pulley tackles by automatic self-detaching hooks. These hooks are so constructed that they hold securely so long as there is any weight suspended on them, but which will free the boat instantaneously as soon as it is fairly water-borne. Another point worthy of notice is that the boats when secured and chocked, are all clear inside the line of rail, and are thus not likely to sustain injury or be carried away by two vessels colliding and rubbing past side by side.

At the trial above mentioned, four men—a boat's crew—were told off to lower away the boat, which was lashed and secured for sea. On a signal being given the boat was released from the chocks, lowered away, raised again, and re-secured as before, in two minutes and a half. Two men are sufficient to lower the boat at the davits, and it can be in the water in a minute's time. This is an enormous saving of time as compared with what is necessary usually to lift a boat from the chocks and to get her into the water. The sea-going value of this gear has been well tested on board the Eastern Telegraph Company's steamship "Retriever," where it is much approved.

LARGE NEW ATLANTIC STEAMSHIP.—The Barrow Shipbuilding Company have been entrusted with an order to build for the Inman Steamship Company a gigantic steamship for the Atlantic service, which will, in dimensions, speed, and appointments, be the most superb steamer in the world.

ADDITIONAL SHIPBUILDING CONTRACTS ON THE CLYDE.

SINCE our last number there has been a great deal of additional progress in the way of placing orders for new vessels several of them being orders of very considerable importance. The first we may refer to being an order for ten vessels, of which eight are placed with well-known Clyde firms—four with Messrs. John Elder and Co., two with Messrs A. and J. Inglis, and two with Messrs. Caird and Co., Greenock. These are vessels of 1750 tons each, and of great speed, and are to the order of the Compagnie Générale Transatlantique, of Paris. It is understood that they are to be delivered in seven and a half months.

Next in importance is an order for a new screw steamer for the Cunard Line of extraordinary dimensions and propelling power. She is to be 500 ft. long by 50 ft. in breadth and 41 ft. in depth, and is to be propelled by a set of engines of the compound, inverted, direct-acting, three-cylinder type, of a total of 10,000 indicated horse-power, while the boiler furnaces are to have 1000 square feet of effective firegrate surface. This new vessel which is to be called the Sahara, is to be of 7500 tons, her only superior as to size up to the present being the Great Eastern. She will be constructed with a double bottom on the longitudinal and bracket system, thus having a water ballast tank capable of taking in 1000 tons of water; while her cargo capacity will be 6500 tons, in addition to bunker space equal to 1700 tons of coal. Her internal arrangements will be designed for 450 first-class and 600 steerage passengers; and as she will have an extra promenade deck, she will practically be a five-decker. Mr. John Burns and his partners have resolved, after much careful consideration, that this new vessel shall be built of Siemens-Martin steel, and that the same material shall also be employed for the boilers and rivets. This resolution, both as to the size and power of the vessel, and the material to be employed in her constructon, may be said to be the most remarkable fact yet announced in connection with the "new departure" in naval architecture. Messrs. James and George Thomson, who have already built such an enormous amount of Cunard steam shipping, have been entrusted with the order to build the Sahara, which they have undertaken to have ready for sea by March, 1881. This very extraordinary steamer will be most anxiously watched, both during her construction and her early history as a Transatlantic liner. Messrs. J. and G. Thomson have also closed a contract with the Canadian Shipping Company of Montreal to construct a sister steamship to the Lake Winnipeg, recently despatched from the Clyde for the company's Liverpool and Montreal service. She will be 355 ft. long by 40 ft. beam, and 3400 tons gross.

The owners of the well-known Allan Line of Transatlantic steamers, Messrs. James and Alexander Allan, Glasgow, have no sooner got their Buenos Ayrean (the biggest steel-built merchant steamer afloat) launched from the yard of Messrs. Denny Brothers Dumbarton, than they resolved to build a still larger one of steel, although not so large as the Cunard liner just spoken of. Messrs. Allan's new vessel has been designed to be of great speed with permanent accommodation for about 200 cabin passengers and to have room also for over 1000 steerage passengers. The Parisian—for that is to be the name of the new vessel—is to be 440 ft. long by 46 ft. broad and 36 ft. deep, and is to be of about 5500 tons gross tonnage. As in the Sahara, there will be a double bottom throughout, with water-tight compartments, and the engines will also be of the three-cylinder type. She is to be ready for sea early in 1881. The order for her construction has been placed with Messrs. Robert Napier and Sons. Much credit is certainly due to Messrs. Allan for the courageous way in which they have identified themselves with the use of steel in the construction of great ocean steamships.

Messrs. Charles Connell and Co., Scotstoun, Whiteinch, have been entrusted with an order for a large screw steamer of over 5000 tons burthen, and of great engine power, being the largest vessel that this firm have ever undertaken to build. The engines for this steamer are to be constructed by Messrs. John and James Thomson, Glasgow.

Another very important order has just been placed with Messrs. A. McMillan and Sons, Dumbarton, namely, one for three steamers of about 3500 tons each for a London firm. The same firm have also concluded a contract for the construction of a sailing ship of 2000 tons, and besides these two orders, they have seven steamers of various sizes in hand.

A contract for a steamer of over 2000 tons. for the Montreal and River Plate trade of Messrs. Donaldson Brothers, Glasgow, has recently been placed with Messrs. D. and W. Henderson and Co., Meadowside, Partick. This is in addition to one ordered several weeks ago from the same builders by Messrs. Donaldson Brothers.

Messrs. Robert Duncan and Co., Port-Glasgow, have just received an order to build two iron barges of 350 tons each for the Irrawaddy Flotilla Campany Limited, whose fleet on that river now consists of 21 steamers and 38 barges. The order just mentioned will make up 40 vessels which Messrs. Duncan and Co. have constructed for the same company within the last ten years. The same builders have also just contracted with Mr. James Galbraith, Wemyss Bay, to build him a steam yacht of 530 tons with compound engines of 500 indicated horse power by Messrs. Rankine and Blackmore, Greenock.

The old-established firm of Messrs. Barclay, Curle, and Co., Glasgow and Whiteinch, are about to build a splendid saloon paddle steamer for the Southampton, Isle of Wight, and South of England Royal Mail Steam Packet Company; and they are to supply her with a pair of compound paddle engines. Messrs. Barclay, Curle, and Co., have already built and engined three steamers for the same company. Messrs. W. Simons and Co., Renfrew, have just closed a contract with the City of Cork Steamship Company to build a steamer of considerable size; and a contract has been closed by a Port-Glasgow firm within the past week or two for the construction of four steamers for the fishing trade. The yard of Messrs. Dobie and Co., which has for some months been quite silent, is now again becoming active, a steamer of 1200 tons having been commenced. There is likewise other work in prospect.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* Marine Engineer *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—Ed.]

LAUNCHES (English.)

Mayo.—On the 22nd October there was launched from the Shipbuilding, Engineering, and Repairing Works of Messrs. Oswald, Mordaunt and Co., Southampton, an iron steamer of the following dimensions:—Length over all, 248 feet; breadth extreme, 33 feet; depth in hold, 18 feet; gross tonnage, about 1,400 tons. This vessel is built to the order of C. W. Pollexfen, Esq., of Liverpool, is of the highest class at Lloyd's, and is fitted with all the modern appliances for working cargo. The decks are of iron. The accommodation for Captain and Officers is placed amidships before the engine-room, with a chart-room and wheel-house above; the Crew are berthed in the topgallant forecastle. She is fitted with a pair of inverted compound-surface condensing engines, with cylinder 56 inches and 28 inches in diameter, having a stroke of 36 inches, working pressure 75 lbs., by Oswald, Mordaunt and Co. The vessel was named the Mayo.

Glenrath.—On the 30th October there was launched from Palmer's Shipbuilding and Iron Company (Limited), Jarrow-on-Tyne, a screw steamer of about 2,600 tons, to the order of Messrs. Lindsay, Gracie and Co., of Newcastle-on-Tyne. This steamer is classsed 100 A 1 at Lloyd's, has two iron decks, extra strengthening, rivetting, and thickness of plates amidships, &c. She will be supplied with Palmer's engines of 160-h.p. nominal. As she left the ways she was named the Glenrath by Miss Gracie, sister of one of the Managing Owners.

Mary.—On the 30th October a screw steamer of the following dimensions was launched from the iron shipbuilding yard of Messrs. John Readhead and Co., South Shields, namely:—length, 243 feet; breadth, 32 feet 9 inches; and depth of hold, 17 feet 6 inches. The steamer has been built to the order of Messrs. R. Harrowing and Co., of Whitby, and is the eighth vessel constructed by Messrs. Readhead and Co., for that firm. As the steamer left the ways she was named the Mary (after Mr. Harrowing's grand-daughter) by Miss Readhead, daughter of the Mayor of South Shields. The vessel will be supplied with engines and boilers, also manufactured by Messrs. Readhead and Co. The engines are on the compound surface condensing principle, and of 115-h.p. The vessel has been classed 100 A 1 at Lloyd's. She will carry about 1,850 tons dead weight, and will be employed in the Mediterranean and general trades.

Concert.—On the 1st November there was launched from the shipbuilding-yard of Mr. J. C. Tolman, Newhaven, the dandy Concert. She was built for R. Hillyard, Esq., of Hull, and is intended for the North Sea fishing.

Enchantress.—On the 3rd November a new screw steamer named the Enchantress was launched from the yard of Messrs. Short Brothers, shipbuilders, Pallion, Sunderland. This is the fourth vessel built by this firm for Messrs. Taylor and Sanderson, of Sunderland. Her dimensions are:—Length, 270 feet; beam, 36 feet; depth of hold, 18 feet 6 inches; being 1,650 tons gross, and having a carrying capacity of 2,200 tons. Her classification will be 100 A1 at Lloyd's. She has an iron deck, long half poop to bridge and short poop abaft, with spare berths for passengers. The Enchantress has been specially designed to carry a large cargo on a light draught of water, and from her lines and the power of her engines, it is anticipated that she will attain a high rate of speed. Four steam winches, large donkey boiler, and other facilities will be put on board for the rapid discharge of cargo. The engines, on the compound surface-condensing principle, have been built by Mr. John Dickinson, Monkwearmouth, are of 160-horse power, and combine all the latest improvements. The steamer has a cutwater and carved figurehead, representing Euterpe, one of the muses. As the vessel left the ways she was named in the usual manner by Mrs. John Sanderson.

Queen.—On the 3rd November, a cutter of 37 tons registered tonnage was launched from the shipbuilding yard of Mr. John F. Picot, of Gorey, Jersey. This cutter, which is named the Queen, is the property of Captain Guille, classed A 1 for 11 years, and is intended for the coasting trade.

Mobile.—On the 12th November, Messrs. Alexander Stephen and Sons launched an iron screw steamer of about 1,420 tons, having the dimensions 250 by 32½ by 22½, and built under special survey to the highest awning deck class in Lloyd's. This vessel, which has been built for the Gulf City Steamship Company (Limited), of Liverpool, was named the Mobile by Miss Ella Herriman, daughter of F. D. Herriman, Esq., of Liverpool, one of the directors of the company. The Mobile is intended for opening up a new trade—that of steam carriage between Mobile and Liverpool. Hitherto on account of the shallowness of the bay at the former city, cotton which would otherwise have been shipped by steamer there has had to be taken by railway to New Orleans for shipment. The Mobile is specially designed to combine light enough draught for loading in the bay with a large capacity for stowage of cotton. The vessel is fitted withw ater ballast and all modern improvements, and, as usual at Linthouse Works, she was launched with engines and boilers on board, ready for steaming.

Europa.—On the 12th November a screw steamer was launched from the shipbuilding yard of Messrs. Charles Mitchell and Co. at Low Walker. The new vessel which was named the Europa, is 260 feet long between perpendiculars, 34 feet beam, and 22 feet 6 inches depth of hold. She has been built to the highest class at Lloyd's, and is fitted with all the latest improvements for easy and economical working. The steamer was built to the order of Edward Carr, Esq., Hamburg; will be commanded by Captain Maack, and will carry 2,200 tons. Her engines will be 150-h.p., and will be supplied by Messrs. Blair of Stockton-on-Tees.

Pilot.—On the 12th November the Pilot, training brig, sister ship to the Nautilus, was launched at Pembroke. The vessel was launched by Miss Lambton, granddaughter of the Earl of Cawdor, the vessel "christening" herself as she descended the slip, the launching apparatus being exactly similar to that used at Chatham at the launch of the Alexandra.

LAUNCHES (Scotch).

Coraki.—The twin screw-steamer Coraki, built by Mr. W. B. Thompson to the order of the Clarence and Richmond River

Steam Navigation Company, was launched from the Caledonian Shipyard on the 31st October. This vessel is sister ship to the Rosedale, which was built last year by Mr. Thompson, also for Australian owners, and is specially adapted for river traffic, having a large carrying capacity with a light draught of water. The Rosedale accomplished the passage from the Bristol Channel to Sydney in 100 days, with an average cosumption of 2¼ tons of coal per day; and the colonial press spoke highly of the trim little craft which was visited by large numbers of people on her arrival in port. In the case of the Coraki the passage to Sydney will be by the Suez Canal, and it is expected to be made in the course of six or seven weeks. Captain Webster, Arbroath, has been appointed to the command of the new steamer, which is 140 feet in length, and 26 feet 8½ inches beam, her tonnage being 276 gross. She is to be fitted with two pairs of compound surface condensing engines of 70-h.p., and an average speed of ten knots an hour is guaranteed with a very moderate consumption of coal. Every appliance has been introduced for facilitating the working of the ship and the loading and unloading of cargo, and ample accommodation has been provided for a considerable number of cabin and steerage passengers. The christening of the Coraki was gracefully performed by Miss Webster, sister of the commander, and hearty cheers were raised when the vessel slipped off the ways into the water. A tug was in attendance, and towed the steamer into Victoria Dock, where she was berthed alongside the large crane, and the work of putting her machinery on board was at once begun, as it is intended to have the steamer fitted out with the utmost despatch. After the launch the company adjourned to the office, where cake and wine were served, and success to the new ship, the builder, and commander were proposed and heartily responded to. Mr. Thompson has at present on hand two steamers, about 1,000 tons each, for local owners, and a number of marine engines to be sent to the East are being constructed at the Tay Foundry.

Kinfauns Castle.—On the 3rd November an addition was made to the Cape Mail fleet of Messrs. Donald Currie and Co., by the launch of the Kinfauns Castle from the shipbuilding establishment of Messrs. John Elder and Co., Govan. The chief dimensions of the new vessel are: Length, 371 feet; breadth, 48 feet; depth, 32 feet 6 inches; tonnage, 3,600 tons. Engines, two cylinders, 51 in. and 88 in. respectively. The new vessel has this peculiar characteristic, that she is the first ocean mail steamer built entirely of steel on the Clyde, or indeed anywhere. Mr. Donald Currie, speaking after the launch, said all the 16 ships of the Cape Line had been accepted by the Admiralty.

Te Anau.—On the 3rd November there was launched from the shipbuilding-yard of Messrs Wm. Denny and Brothers, Glasgow, a screw steamer of 1,600 tons, named the Te Anau. Her principal dimensions are:—Length between perpendiculars, 270 feet; breadth moulded, 34 feet; depth moulded, 25 feet. She is to the order of the Union Steamship Company of New Zealand (Limited), and is classed at Lloyd's 100 A, and built entirely of steel. She has a double bottom, capable of containing 293 tons of water ballast, and is fitted with accommodation for 126 first and 87 second class passengers. She is schooner-rigged, and her masts are of steel. All the wood-work and decorative work is similar to that of the Rotomahana, lately launched for the same company. She will be engined by Messrs. Denny and Co. with compound direct-acting engines of 207 nominal horse-power. The ceremony of naming the vessel was performed by Miss Julia Robson, of Westhall, Dumbarton. The Te Anau is the sixth ship built by Wm. Denny and Brothers for the company, and they have a seventh in progress.

Cipero.—On the 5th November there was launched from the shipbuilding-yard of Messrs J. and G. Thomson, Clydebank, an iron screw steamer of 1,800 tons, 800-h.p., and classed 100 A 1 at Lloyd's. This vessel has been built to the order of Messrs. David Caw and Co., of Glasgow, for the Direct Line service between Glasgow, Trinidad, and Demerara, and is sister ship to the Belair, recently launched. The ceremony of naming the vessel Cipero was performed by Miss Wilson, daughter of Provost Wilson, of Govan.

Grandtully Castle.—On the 13th November Messrs. Barclay, Curle and Co., one of the oldest shipbuildihg firms on the Clyde, launched from their yard at Whiteinch another steamer for Messrs. Donald Currie and Co., to augment the Cape mail service. A few days ago, Messrs. John Elder and Co., it may be remembered, launched the Kinfauns Castle for service on the same route, and with the exception that the present vessel named the Grandtully Castle by the Countess of Breadalbane, is built of iron and the other of steel, there is little difference in their general arrangements. Being, however, constructed of iron, she is heavier than her sister ship, her tonnage being given at 3,650. Her length is 370 feet, breadth, 43 feet, depth 32 feet 6 inches. she is the 290th vessel built by Messrs. Barclay, Curle and Co., and the 27th entrusted to that firm by Messrs. Currie, the first being finished in 1863, to ply betweed Leith and Hamburg. Since then, Messrs. Barclay, Curle and Co. have built several of the "Castles" the present of which is the largest of the number. Like her sister ship she has a double bottom, fitted up to carry 500 tons of water ballast. There are nine water-tight compartments, and between the upper and main decks five fireproof bulkheads have been constructed for additional security against accident. The Grandtully Castle is classed 100 A 1 at Lloyd's, and two of the iron decks are planked with four inches of teakwood. The engines are of the compound inverted cylinder class, and are expected to indicate over 2,800-h.p. She will have accommodation for about 140 first, 110 second, and something like 100 third-class passengers, and her internal fittings will be of the finest and most improved description. Like the other recent additions to the Donald Currie fleet, she is constructed in accordance with the requirements of the Admiralty for merchant ships available for use as an auxiliary war cruiser. The ship is the seventeenth of Messrs. Donald Currie's Cape and Natal Mail fleet.

Paragon.—On the 15th November Messrs. Stephen and Forbes launched from their shipbuilding yard at Peterhead a clipper schooner named the Paragon, of 120 tons gross register, for the Leith and Kirkwall trade. Her dimensions are 85 feet keel, 22 feet beam, and the depth of hold 10 feet 3 inches. Having been built under cover she is classed A 1 at Lloyd's for 11 years. She was christened by Miss Janet Lyell, niece of Mr. Forbes, one of the builders.

Amerique.—On the 15th November Messrs. A. M'Millan and Son, launched from their dockyard at Dumbarton the steamer Amerique, for the French mail and passenger service of Messrs. Fraissinet and Co., of Marseilles. The Amerique has a capacity of 3,000 tons dead weight, and is being supplied by Messrs. Denny and Co. with engines of 1,500 indicated horse power. This vessel is intended for the French mails and passengers to the coasts of Italy, Egypt, Asia Minor, Greece, and Turkey, and has considerable accommodation for first and second class passengers. The Amerique is fitted with everything usual in first-class passenger steamers of the present day, and was named by Miss M'Lellan, of Helensburgh.

Athos.—On the 17th November Messrs. Charles Connell and Co. launched at Scotstoun, an iron screw steamer of about 2,000 tons gross, built to the 100 A 1 class at Lloyd's. As she left the ways she was named Athos by Miss Cecy Harvey, Park-terrace, Stirling. This vessel, which is fitted with accommodation for 60 first-class passengers and with every modern improvement for carrying purposes, has been buit for the Atlas Steamship Company, of Liverpool, to the order of Messrs. Leech, Harrison and Forwood, the Managing Owners, and will be placed by them on their mail service between New York and the West Indies. The machinery will be supplied by Messrs. John and James Thomson, Finnieston Engine Works.

Heather Bell.—On the 18th November there was launched from the building-yard of Messrs. Barr and Shearer, Ardrossan, a clipper-schooner, of 220 tons, classed A 1 at Lloyd's. This fine little vessel will sail under Messrs. Boustead and Dunbar's flag in their French and Spanish trade. On her leaving the ways she was named the Heather Bell, by Miss Haddow.

IRISH.

Homehurst.—On the 5th November, a small steamer called the Homehurst was launched from the shipbuilding-yard at the Queen's Island, Belfast. The vessel, which has been built to the order of the Burnley Colliery Company, is about 600 tons burthen, and fitted with a propeller possessing all the latest improvements. She is a sister vessel to the Thursby, and is intended for the cross-Channel trade.

TRIAL TRIPS.

Mendoza.—On the 24th October the new screw steamer Mendoza proceeded down the Firth of Clyde on her trial trip, after having had her compasses adjusted in the Gareloch. The Mendoza, which was launched from the shipbuilding yard of Messrs. Robert Napier and Sons, Govan, about five weeks ago, and has been built to the order of the Pacific Steam Navigation Company, Liverpool, is a sister ship to the Pizarro, belonging to the same company, which left the Clyde about the middle of last month, and is 2,500 tons burthen. As in the case of the Pizarro, the Mendoza has been specially designed to meet the requirements of the Coasting Trade of South America, between Callao and Valparaiso, for which she has been constructed. She is built of Siemens-Martin steel, supplied by the Steel Company of Scotland. The main deck has been specially fitted up for cattle, and accommodation is provided for a very large number. Above the main deck an awning deck has been fitted up right fore and aft, and on the top of this there is a range of deck-houses, giving accommodation for 100 first-class passengers. The most modern appliances have been supplied for the rapid loading and discharging of cargo and the efficient working of the vessel. The Mendoza has been supplied with compound engines of 2,300 indicated horse-power. On the day of the trial she was steamed to Wemyss Bay, where the measured mile was run. She made six runs altogether, and the speed attained was 142 knots an hour, which was considered highly satisfactory. The Mendoza is to be commanded by Captain Bermy.

Lady Havelock.—On the 25th October, the Lady Havelock (s), owned by Messrs. Thomas Baker and Son, of Cardiff, ran her official light draught trial, after having been fitted with new machinery and undergone extensive alterations, executed by the Globe Dry Dock Company, Swansea. The result of the trial was most satisfactory, the speed attained being in excess of the most favourable anticipations, namely, 11 knots per hour. The dimensions of the ship are 206·5 by 24·2 by 14·2. The boiler is of the cylindrical multitubular type, with three furnaces, and constructed of Landore Siemens steel; working pressure, 80lbs. per square inch. The engines, of 80 nominal horse-power, are on the compound direct-acting surface condensing principle, fitted with all the latest improvements for obtaining a high indicated power and low consumption. The number of revolutions obtained was 85 per minute, and when the vessel was taken out on her loaded trial previous to her proceeding on her voyage, a speed of 10 knots was obtained on 74 revolutions and 80lbs pressure. The engines worked with smoothness, and her boiler sustained easily a full command of steam. The engines were constructed by Mr. James Nelson, of Gateshead-on-Tyne.

Hong Ann.—On October 25th the Hong Ann, a new steamer fully laden, built and engined by Messrs. Wigham Richardson and Co., Newcastle, to the order of Messrs. Scott and Co., London, after adjusting compasses, had a successful trial trip at sea. The Hong Ann is specially designed for passenger and cargo service in the far East, under the superintendence of Captain Mackenzie, who has arranged to place her on her station at Singapore.

Mokta.—An iron spar-decked screw-steamer, named the Mokta, just completed by Messrs. Schlesinger, Davis and Co., Wallsend-on-Tyne, has just had her trial trip. She is a sister ship to the steamship Laurium, recently finished by the same builders for Messrs. Poingdestre and Mesnier, of Swansea. The leading dimensions of the Mokta are as follows:—Length between perpendiculars, 253 feet; breadth moulded, 33 feet; and depth, 23½ feet. She takes Lloyd's highest class of 100 A1, and has been constructed under special inspection. The officers are all berthed amidships, under an iron house, 80 feet long. Two round iron lighthouses are built on either side of the bows, and are connected together by a look-out bridge. The engines are from the celebrated firm of Messrs. R. and W. Hawthorn, of Newcastle, are of 150 nominal horse power, and fitted with their special steam starting gear and other arrangements for economical working. The engines ran exceedingly well during the trial, which lasted several hours, the results attained with a cargo 1,900 tons on board being 10½ knots.

Gleadowe.—On November 3rd the screw-steamer Gleadowe, built by Palmer's Shipbuilding and Iron Company (Limited) for Messrs. Hunting and Pattison, Newcastle, had her trial trip at sea. The vessel is 285 feet long, 37 feet broad, and 24½ feet deep, her carrying capacity being 2,300 tons, and her engines, supplied by Palmer's Company, are of 250-horse power nominal. The steamer has been built nnder special survey, and is classed 100 A1 at Lloyd's. She has been built under the superintendence or Captain Brunton, the eoection of the engines having been superintended by Mr. William Whyte, Lombard Street, Newcastle. The Gleadowe, which is the third steamer built by Palmer's Company for the same firm this year, is fitted with all the latest improvements, including Donkin and Nicholl's steam steering gear, which on the trial worked satisfactorily.

Mary Monica.—On November 4th the trial trip took place of the Mary Monica, recently built by Murdoch and Murray, Port-Glasgow, and engined by J. and T. Young, Ayr. The vessel left Ayr Harbour at 8 a.m., and ran the measured mile at the rate of 10 knots, which was considered satisfactory. After the compasses were adjusted, the vessel proceeded to Ayr to load for Dublin.

Ardington.—On the 5th November the iron screw steamer Ardington, built by Palmer's Company, Jarrow, for Messrs. Lee and Finch, Cardiff, was taken out to sea for her trial trip. The Ardington measures 235 feet in length, by 32 feet in breadth, and 18 feet 9 inches in depth, and her carrying capacity is over 1,800 tons dead weight. She is classed 100 A1 at Lloyd's, having been built under special survey. After having her compasses adjusted the Ardington was taken to the north of the Tyne for a couple of runs over the measured mile, the result of which was a mean speed of 11 knots per hour. After the trial the Ardington was taken to the Northumberland Dock, to take in a cargo of coals for Port Said, in charge of Captain Pawley.

The Belair.—On the 10th November the trial trip of the screw steamer Belair took place. The weather was very fine. After running the measured mile, in which she attained a speed of about 10½ knots per hour, the ship proceeded down the Firth of Clyde and back to Greenock. The Belair was launched from the yard of Messrs. J. and G. Thomson at Dalmuir three weeks ago. She is 253 feet long, 32½ feet broad, 19 feet 3 inches deep, and her carrying capacity 1,800 tons. Intended as she is to carry a large quantity of sugar on her voyages from Trinidad and Demerara to this country, special facilities are provided for that purpose, and while the cargo space has been carefully looked after, the passenger accommodation has not been neglected. Her engines, which worked very smoothly during the trial, are of the compound condensing cylinder class, and indicated 900-horse power.

The Coraki.—This steamer, which was recently launched by Mr. W. B. Thompson for the Clarence and Richmond River Steam Navigation Company, Sydney, made her trial trip on the 13th of November, when it was decided that the steamer, having been built for river traffic should proceed up the Tay, instead of round the Bell Rock, as is usual on such occasions. After a trip to Newburgh, the more intricate passages of the river were reached, when the Coraki proved herself adapted for narrow waters and acute turnings. This was specially exemplified when the vessel had to go about shortly before reaching Perth. The river at this point is about 420 feet broad, and the steamer—140 feet long—turned at once on her own length, thus proving the peculiar adaptability of the twin screws for navigation of this character.

Argosy.—On the 19th November the screw steamer Argosy, built by Messrs. M. Pearse and Co. at Stockton, had her trial trip before proceeding on her first voyage. The steamer is 275 feet in length by 35 feet 6 inches beam, and 24 feet depth of hold. She is schooner-rigged, with two iron lower masts; has two decks, one being iron, large bridge-house, and topgallant forecastle. The vessel is fitted with double bottom in both holds, for water ballast, and efficiently supplied with longitudinal shifting-boards and additional transverse bulkheads to prevent grain cargoes shifting. In her iron mainhold there are a number of feeders to allow grain to flow into the lower hold as by the roll of the steamer that portion of the cargo gradually settles, and thus allows it to shift by the heave and pitch of the ship. In this vessel that will be prevented by these feeders continually filling up the space made by the settling of the grain. There are also several large ventilators or manholes from the upper deck, by which a person may descend into the hold and see that the cargo is properly stowed. The Argosy is of 1,870 tons gross register, with a carrying capacity of 2,900 tons, and is classed the highest at Lloyd's and is intended for the Atlantic and Indian trades. Her engines, by the firm of

Messrs. Blair and Co., Limited, Stockton, are on the compound surface-condensing principle, of 150-horse power nominal, having steam turning and starting gear. Her steering apparatus is also worked by steam. She has been built to the order of Messrs. Hodgson and Eccles, of Blyth, and will be commanded by Captain Peak. Her first voyage will be from Middlesbrough to New York with a cargo of pig iron. Leaving Middlesbrough Dock, the Argosy proceeded under easy steam into the Tees Bay, where her compasses were adjusted and her head turned towards the Tyne. In the trial of speed the vessel made about 10 knots per hour, her engines working very satisfactorily. With over 2,300 tons on board, the steamer's sea-going capabilities proved her to be fully adapted for the trade she is designed for.

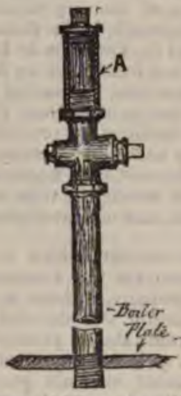
Correspondence.

[It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.—Ed.]

PRIMING IN MARINE BOILERS.

To the Editor of the Marine Engineer.

Sir,—In reply to a "Puzzled Engineer," I enclose a rough sketch of a piece of 1-inch piping and cock I fitted in a boat I was in, which was very effectual in stopping priming. Whenever she began to thump I would put a small quantity of tallow into the top pipe, marked A, screw on the cap, and let the tallow into the boiler (near the centre of the boiler is the best place to screw in the pipe), and it would at once stop the nuisance. If your correspondent adopts this plan he will find it as well to charge the pipe with tallow directly after use, then there is no delay when it is wanted.



E. S. H.

PRIMING IN MARINE BOILERS.

Dear Sir,—In your issue of November 1st I see a letter signed "Puzzled Engineer," asking for some advice on a priming boiler. Considering the limited description given, unaided by drawings, I am afraid your readers will not be in a position to give the writer much wholesome advice. Had the writer given some of the dimensions and peculiarities of his boiler, one might have ventured on a reason why it primed, but a perfect cure is, I am afraid, no easy matter. In a great many cases the boilers in steamers are too small for the work they have to perform, and the heating surface is too great for the dimensions of the boiler. If steamship owners would either make their boilers larger (and pay for large ones), or reduce the tube surface 20 per cent., priming boilers would be fewer and the boilers would then do their work with greater economy, and at the same time give easy facility for cleaning. When compound engines came into general use, with steam at 60 lbs. per square inch, ship owners stated the boilers were very expensive to keep up, and that the average lifetime of a 60 lb. pressure boiler was five years. A great many owners now find that, with boilers working at 80 lbs. pressure, when properly designed and constructed, the repairs are less costly, and the boilers will last fully as long as 30 lb. pressure boilers made 15 years ago. Give plenty of room in boilers and there will be no trouble from priming, &c. The general rule in designing boilers for the Company I am with is to give $4\frac{1}{2}$ inches in height from tubes to boiler crown for every foot the boiler is in diameter, and give at least a steam capacity equal to 40 times the capacity of high-pressure cylinders; the space between the tubes, $1\frac{3}{4}$ inches, and from boiler shell to tubes, $13\frac{1}{2}$ inches; between each box of tubes, $13\frac{1}{2}$ inches, and from furnace crowns to tubes, $10\frac{1}{2}$ inches.

The fire boxes at back ends we make same width as the diameter of furnaces. The feed-water is delivered into steam space, and the steam for the engines is taken off the boilers at smoke-box end of the boilers. I may say we have not such a thing in the whole fleet as a priming or a dirty boiler. Perhaps this may let "Puzzled Engineer" know what some Companies do to prevent priming, and, at the same time a considerable amount of economy is gained.

Yours truly,

Glasgow, 8th Nov., 1879. Chief Engineer.

ACID FOR REMOVING SALT OFF BOILERS.

Dear Sir,—Will you please kindly ask, through the medium of your correspondence, what is the best acid for removing salt off boilers?

N. T.

Southampton, *September* 31*st*, 1379.

Sir,—I am a sea-going engineer, and a subscriber to your paper, the "Marine Engineer." I am keeping myself well up in algebra, trigonometry, mechanics, &c,, and am very desirous of getting a good situation at home as superintendent, surveyor, or something after that style, and at this port there are two—the surveyor (Board of Trade) and an assistant. Could you kindly, through your correspondence column of your next number, give me some idea of how the situation of Board of Trade surveyor (marine) may be obtained? If you can you will extremely oblige

Your humble servant,

A Subscriber.

(The appointments are in the hands of Mr. Thomas Traill, chief surveyor of Board of Trade, and they depend upon qualifications and interest at head quarters. Ed. *M. E.*)

Review.

How to make Knots, Bends, and Splices, as used at Sea. By Tyrrel E. Biddle,—P. Wilson, 157, Leadenhall Street, E.C.

The author of this useful little treatise, evidently fulfils a want which, as he explains in his preface, has arisen in consequence of the modest subdivision of the labour of erecting a vessels masts and rigging. Where, formerly, a seaman knew a little of everything and often had to assist in the fitting of his vessel, especially after any mishap at sea, a good knowledge of the various modes of knotting and splicing ropes came to him as a matter of course, and almost intuitively. Nowadays where repairs are generally made in the yard, he has to learn the various modes deliberately, and theoretically, before, perhaps, any opportunity occurs to enable him to acquire them practically. To such, and to yachtsmen, this work will prove very useful being succint, and at the same time clear and illustrated by well drawn cuts explanatory of the letter press.

The Yacht "Wanderer."—An order for new engines and boilers for this magnificent yacht—the largest in the world, we believe, belonging to a private owner—has been given to Messrs. Day, Summers, and Co., of the Northam Ironworks, Southampton. The new machinery will consist of a pair of 100-horse power nominal, with steel boilers, working at a pressure of 80 lb. per square inch, the specifications for which have been drawn up by Mr. Harrington, of Gracechurch Street, London, the consulting engineer of the owner of the Wanderer, Mr. C. J. Lambert.

Recent Applications for Patents connected with Marine Engineering, Ship Construction and Mechanical Appliances for use in Ships, from October 21st to November 20th, 1879.

Supplied by the City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

4273 W. Tully. Securing boiler tubes, &c., in plates
4275 C. T. Bradbury and W. J. Prestwich. Boiler furnaces
4277 C. A. Maynard. Prevention of fraud in collection of fares on boats, &c.
4282 W. Rennie. Loading and unloading vessels
4284 O. C. Mootham. Oars and Sculls
4296 C. Kesseler (communicated by E. Brauer). Prevention of back motion and reduction of friction of toothed wheels in pulley blocks
4298 F. C. Francis Apparatus for signalling
4333 J. Everding. Steam generators
4337 C. W. King and A Cliff. Obtaining motive power
4343 W. W. Box. Securing glass in frames for lanterns, &c.
4349 S. C. Davidson. Steam boilers
4350 V. Coombe. Sail hanks and fastenings
4351 G. and J. Weir. Steam engines and boilers
4355 W. Davis, J. Walker and W. H. Willcox. Draining steam pipes, &c.
4357 E. Power (communicated by W. Stoll). Grain elevators
4360 W. R. Lake (communicated by O. E. Huss). Shroud-blocks
4367 J. Hastie. Hydraulic motive power and pumping apparatus
4368 J. Lockwood. Mechanical stokers
4369 T. Hawthorn. Waste steam condenser
4371 C. Jones. Screw propellers
4374 S. Pitt (communicated by H. M. Jepsen). Cleaning ships' bottoms while in motion
4379 W. Murdoch. Valves
4380 A. Louttit. Azimuth compasses
4387 N. D. Spartali. Propellor shafts and connecting rods
4393 J. S. MacArthur. Sheet metal kegs, &c. for paint, &c.
4398 H. J. Haddan (communicated by E. E. Many). Signal buoys
4410 W. Young. Means of detecting inflammable gas in ships, mines, &c.
4412 R. Whitefield. Valve
4416 A. M. Clarke (communicated by A. Elvin) Steam boilers and furnaces
4434 W. Black and T. Hawthorn. Waste steam condenser
4437 J. G. Jones and J. B. Saunders. Deep sea sounding apparatus
4438 T. H. T. Engell (communicated by A. B. Hennicke and H. J. Goos) Pneumatic grain elevator
4446 T. Balls. Preservation of fishing nets
4449 C. G. Class (communicated by T. E. Bucknall). Prevention and removal of incrustation in steam boilers
4470 J. L. Clark and J. Stanfield. Piers, breakwaters, &c. apparatus and construction
4497 P. Jensen (communicated by G. Hagelin). Steam engines
4503 T. B. Brodbelt. Steam generators
4504 J. McCarthy. Saving life at sea
4515 J. L. Corbett, W. Lockhead, D. Hosie. Propelling and steering vessels
4517 H. J. Harman. Fusible boiler plug
4535 P. G. B. Westmacott. Dredging, lifting, discharging, loading and conveying grain, &c.
4539 W. H. Watling Davit gear and anchor manipulating gear
4557 J. N. Floyd. Lubricators
4572 W. R. Lake (communicated by E. Holmes and E. T. Greenfield). Telephonic conductors and cables
4574 J. E. Liardet. Propeller
4585 C. Kesseler (communicated by A. Jaeger). Steam fog horns
4593 W. Moseley. Electrical signal or indicator
4605 G. Platts and F. Woods. Fusible boiler plugs
4614 J. Darby. Supporting, freeing, lowering and raising boats
4623 R. Watkins. Furnaces
4640 H. J. Haddan (communicated by G. Minisini). Obtaining motive power from motion of ship or waves, and application to pumps
4644 T. H. T. Engel (communicated by G. T. and W. Leser). Water gauge valves
4650 J. Rochford. Generation and application of oxygen and hydrogen for combustion in steam boiler furnaces, &c.
4658 J. Imray (communicated by W. Siller). Rotary slide valves
4669 H. Studer. Construction and manufacture of armour plates
4670 T. McCarter and T. Cooper. Construction of steam ships
4674 W. T. Goodwin. Steam engines
4708 J. White. Electric bell signals
4710 W. Sayer. Vacuum stopping, reversing apparatus for torpedo boats, &c.
4733 G. Wilson. Propulsion of vessels, &c.

Notes and Novelties.

THE GROSSER KURFURST. A well-informed correspondent, writing from Kiel, says,—"The intelligence received here for some time past with respect to the operations connected with the projected raising of the Grosser Kurfurst, are calculated only to confirm the doubts and objections which were raised from the outset, in competent professional circles, against the possibility of the success of the enterprise. It is, at any rate, now pretty certain that any practical attempt to raise the vessel is for the present year out of the question, and it would appear questionable whether the supreme naval authorities of Germany will be prepared to agree to a prolongation of the contract with the contractors for an indefinite period.

MR. E. J. READ, C.B., M.P., the designer of the Chilian ironclads which captured the Huascar, has received the following letter from his Excellency the Chillian Ambassador to France and England:—Chilian Legation, Paris, November 17, 1879, Dear Sir,—I am very happy to inform you that his Excellency the President of Chili, in a telegram sent to the Chilian Legation at Buenos Ayres and conveyed to me by the last mail, speaks in high terms of the excellent qualities shown by the two ironclads, the Almirante Cochrane and the Blanco Encalada, in their engagement with the Huascar. The Blanco Encalada sustained no damage at all, and the Almirante Cochrane, that took the principal part in the fight, was but slightly injured, both giving proof of their handiness and strength in a very remarkable way. His Excellency directs me to congratulate you as the designer of these vessels, and I am very happy that, after having followed your professional advice in adopting their type, and after having entrusted to you the superintendence of their building, I am now charged with the very pleasant mission of giving you this testimony of the complete success attained by your professional skill. Believe me to be, with very high consideration, yours faithfully, A. BLEST GANA."

THE CZAR'S GREAT YACHT.—On Monday the steel model of this yacht, 24 ft. long by 15 ft. broad, left the tidal basin of Messrs. John Elder and Co., Govan, and shortly afterwards proceeded up the river as far as the Patrick Wharf, where it landed his excellency Admiral Popoff, of the Russian Navy, who was on board. The peculiar appearance of the model, with its remarkable proportions, attracted considerable attention, She only drew a few inches of water, and steamed very smartly. The great yacht itself is progressing rapidly in Messrs. Elder's yard, and its ultimate completion will be watched with interest.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Mr. John Miller, President of the Graduates' Section of the Institution of Engineers and Shipbuilders in Scotland, delivered the opening address for the session 1879-80 on the evening of the 11th inst. In the course of his address, he said that since the delivery of his first presidential address a twelvemonth ago, very considerable progress had taken place in the manufacture of steel in Scotland, as also in the confidence which shipowners were displaying in regard suitability of the material for shipbuilding and boiler-making purposes, A couple of years ago the use of steel for shipbuilding was almost a novelty, and even a twelvemonth ago comparatively few vessels had been built of the material on the Clyde. Of late, however, almost every shipbuilding firm on the Clyde have been entrusted with orders for one or more steel vessels, while from one yard no fewer than eleven steel-built vessels had already been turned out during the present year, varying very much both in size and character, and one of them being a large Transatlantic line of 4000 tons, which was the largest steel-built vessel afloat. That vessel had in no mean degree been the means of calling forth orders for a number of other vessels to be constructed of the same materials, two of which Mr. Miller specially dwelt upon. Mr. Miller subsequently made some interesting remarks upon the question of utilizing steel scrap, explaining that the material in question could with ease and advantage be welded up into billets and rolled into bars which possesed even a greater tensile strain than was required in the conditions laid down by Lloyd's and by the Board of Trade. He afterwards referred to several important civil engineering works, chief amongst which was the Forth Bridge. At the close of the address a very cordial vote of thanks was awarded to Mr. Miller.

The Electric Light on Shipboard.—The Pacific Steam Navigation Company have begun to use the electric light in the illumination of the saloons on board their steamers. The light was tried in the saloon of the new steamship Mendoza, belonging to that company, as she came round from Liverpool to Glasgow, a simple gramme machine and service lamp, employed for the illumination of Messrs. Napier Brothers' boiler-shop, being used for the occasion. The satisfactory result of this trial is now manifest by the fact that the Pacific Company have entrusted the British Electric Light Company with the work of fitting two electric lights, produced by means of Blandy's patent, from one small gramme machine, in the saloon of the Mendoza. This ship is intended for service on the West Coast of South America. The particular method of applying the light, which has been selected by Mr. Radcliffe Ward, the electrical engineer to the British Electric Light Company, is by reflection from special reflectors in the ceiling of the saloon. The result is a beautifully diffused soft light that effectively exhibits the taseful painting of the saloon panels. On Saturday several of the directors of the Pacific Steam Navigation Company, with some friends, had lunch on board. The shutters of the saloon were closed, and the electric light was used to illuminate the apartment throughout lunch, with the exception of a few minutes when it was turned out to show the marvellous difference between it and the usual candle-light, which involves about double the expense of the electric light. The success of the light on board the Mendoza will probably lead to the adoption of similar lighting on board all the principal ocean steamships. The illumination of the state rooms in the incandescent system, in one form or other, is likely to be accomplished before long. The boon to passengers of being able to turn on a bright settled light at desire will be very great. In this case the light will be placed in globes hermetically sealed.

The Thunderer Experiments.—The experiments to be carried out at Woolwich by the recently-appointed Committee on Ordnance with the companion gun to that which burst in the fore turret of the Thunderer are expected to commence early next month. Colonel Harris, R.A., who on his return from Bombay was appointed on the Committee as representative of the Indian Service, is now at Gibraltar, and his place has consequently been supplied by Colonel MacFarlan, R.E., lately returned from Afghanistan. The other members of the Committee are Major-General Gordon, C.B., R.A. (President), Rear Admiral H. Boys, R.N., Colonel Inglis, R.E., Colonel Owen, R.A., Lieut.-Colonel Maitland, R.A., Captain Cyprian Bridge, R.N., and Major C. H. Fairfax Ellis, R.A. (Secretary). A programme of experiments was proposed to the War Office by the Admiralty, and accepted with a very slight modification. In the first instance trials will be made of the effect produced by leaving a space between the powder and the shot. For this purpose the gun will be loaded with 85 pounds of powder and an empty common shell. The space left in the first round will be two feet, and this will be increased in the successive rounds to four, six, eight, and ten feet. Supposing the gun to stand this ordeal, trial will be made in the next instance to ascertain the effect of a "jam." This also will be made at varying distances inside the gun. If the gun still remains intact, the *coup de grace* will be attempted by giving the gun a double loading, consisting of 110lbs. powder and an empty Palliser shell, with 85 pounds of powder and a common shell in front. According to the report of the Thunderer Committee, it was this latter condition of things which caused the disastrous explosion of the 38-ton gun last January. Although the report of the Committee was very generally received as correct, opinions still differ on the subject, and very good authorities are at variance as to the probable result of the forthcoming experiments. Throughout the programme the powder employed will be of the P 2 description consisting of cubes an inch and a half thick, and the powder and the protectiles will, in all instances, correspond to those used on board the Thunderer.

Shipbuilding in Paisley.—Among several orders secured by Messrs. H. M'Intyre and Co,, shipbuilders, Paisley, there is one for a screw steamer of 1,600 tons, which is considerably larger than any vessel previously built on the Cart, and another for a steamer of 600 tons, which is to be engined by the new local firm of engineers, Messrs. Fleming and Ferguson. The engines are to be of 350 indicated horse-power, with steel boilers. Messrs. Fleming & Ferguson have also on hand orders of a similar pair of engines for Messrs. J. Hay and Sons, Glasgow, and a larger pair for Messrs. Ramage and Ferguson, shipbuilders, Leith.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 c denotes Extra First Class; 1 c, First Class; 2 c, Second Class.

Bedlington, J, C.	2 c	Bristol
Walker, Alex. B.	2 c	London
Williams, W. F.	2 c	do.
Miller, David	2 c	do.
Philp, Geo. C. S.	2 c	do.
Watson, T. F.	1 c	do.
Robertson, Hugh	1 c	do.
Lang, William	2 c	Cork
Vaughan, C. J.	2 c	N Shlds
Armstrong, R.	2 c	do.
Young, Jno.	2 c	do.
Greaves, Robert	2 c	do.
Smith, Jno. W.	2 c	do.
Thompson, T. R.	2 c	do.
Smith, Hugh	1 c	do.
Napier, Edward	2 c	Abrdn
Sang, Jno. Leslie	1 c	do.
M'Andrew, Alex.	1 c	Hull
Quick, W. James	1 c	do.
Cross, Wm. James	2 c	London
Macpherson, J.	2 c	do.
Greaves, V. E.	2 c	do.
Tricker, Chas. H.	2 c	do.
Gore, Robert	2 c	Lvrpool
Barber, John	1 c	do.
Rowland, G. P.	1 c	do.
Inverarity, T. D.	2 o	Dundee
Johnston. George	1 c	do.
Knox, G. J.	1 K	London
Middleton, S.	1 c	do.
Nash, James	2 c	London
Phillips, Henry	2 c	Lvrpoal
Elmsly, James C.	2 c	do.
Hislop, Dugald.	2 c	do.
Jones, David E.	2 c	Bristol
Dixon, George	2 c	N Shlds
Stansfield, Robert	2 c	do.
Pellew, Sydney	2 c	do.
Kirtley. Wm. J.	2 c	do.
Ellison, William	2 c	do.
Harrold, Thomas	2 c	do.
Annisan, Thomas	2 c	do.
Guard, James H.	1 c	do.
Bove, Frederico	1 c	do.
Strenach, John	1 c	do.
Chipchase, John	1 c	do.
Mills, John	1 c	do.
Farquharson, C.	1 c	Greenk
Shaw, John	1 c	do.
O'Onie, James	1 c	do.
M'Kellar, John	1 c	do.
Amour, James H	1 c	Greenk
Deuchar, Alex. J.	1 c	Lvrpool
Thompson, James	1 c	N Shlds
Douglas, Geo. G.	1 c	do.
Sanderson, Ed.	1 c	do.
Marr, Alexander	1 c	do.
Buckley, Alfred	2 c	Lvrpool
Bartlett, Alex. M.	1 c	do.
Paton, Robert E.	1 c	do.
Colyer, Richard J.	1 c	do.
Kerman, Walter	1 c	Bristol
M'Kenxie, D.	1 c	Greenk
Irvine, Jno.	1 c	do.
Smith, Robert G.	1 c	do.
Dalglish, Jamcs	1 c	do.
Counell, Jepson	2 c	Cork
Urie, Thomas	2 c	Glsgow
Macdonald, J.	2 c	do.
Wallace, William	2 c	do.
Allan, John	1 c	do.
M'Intyre, D.	1 c	do.
Brown, James	1 c	do.
Statham, George	2 c	Snderld
Emmerson, W. J.	1 c	do.
Smith, William	1 c	do.
Reynard, William	1 c	do.
Calvert, Arthur	1 c	do.
Gregory, R.	2 c	London
Clee, Joseph	2 c	do.
Salfour, R.	2 c	do.
Cain, Edward	1 c	Lvrpool
Dunn, Wm. M.	1 c	Bristol
Cube, Frederic C.	1 c	Hull
Mills, George E.	1 c	N Shlds
Shronder, Thomas	2 c	Lvrpool
Steel, James	1 c	do.
Adamson, Henry	1 c	do.
Connell, Peter	1 c	London
M'Kenzie, Alexr.	1 c	do.
Coatsworth, Jno.	1 c	do.
Scotland, R. A.	2 c	Leith
Swan, David	2 c	do.
Johnstone, Daniel	2 c	da.
Robertson, Thos,	2 c	do.
Greig, James	2 c	do.
M'Rae, Alexander	1 c	do.
Clark, James	1 c	Lvrpool
Deans, Frank	1 c	do.
Ireland, John	1 c	do.
Faull, Wm. J. H.	2 c	Plymth
Stephens, R. T.	2 c	do.

Robert Jackson, Registrar-General.

General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

Robert Walker's Patent Hydro-carbon Furnace and Apparatus,

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of hydro-carbon fuel burned by this patent furnace and apparatus, generates as much steam as five tons of coal.

2.—One ton of coal measures (according to naval allowance) 48 cubic feet; one ton of Hydro-carbon only measures 17⅓ cubic feet. The difference, then, in favour of Hydro-carbon is 30⅔ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3,000 to £4,000 per voyage.

3.—Economy of 70 per cent. in manual labour.

4.—Regularity of combustion and equality of temperature.

5.—Instantaneous extinction or diminution of fires in case of need, or where required.

6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no burning cinders being projected.

7.—Absence of loss by smoke, cinders, ashes, &c.

8.—Cleanliness.

9.—The fuel can be utilised to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz , the Captain.

10.—The control of the fires can be in the hands of one responsible person.

11.—The existing abundance of Hydro carbons for the purpose.

12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

The INVENTOR'S RECORD.—Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S. (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has gone at once to the root of the matter by dispensing entirely with coal.

The RAILWAY RECORD states: "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger-steamers."

The MARINE ENGINEER.—For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas, they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she requires to take on board at Southampton 800 tons of steam coal costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals. would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons, and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo, it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage.

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements aro equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"Thus in one of our Transatlantic steamers, the space that could be economised when filled with freight, at the present rate, would give us £3,000 (15,000 dols.) over our present receipts. These advantages are immense and must eventually effect a complete revolution in our present mode of steam generation."

For all particulars respecting cost of the Patent Hydro-carbon Furnace and Apparatus and terms of Royalties, application should be made to the patentee, Mr. Robert Walker, C.E., 19, Buckingham-street, Strand, W.C.

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SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is Five Shillings per annum.

The Marine Engineer.

LONDON, JANUARY 1, 1880.

EDITORIAL NOTES.

WE note that some of our practical readers have given some valuable suggestions as to the prevention of priming in sea-going boilers. This tendency to prime, where existing in any boiler is a most trying defect for the engineers in charge. The loss of economy, occasioned by a portion of the contents being sent over as hot water to the engine represents a considerable percentage, and at the same time the danger to the cylinder covers is great. We note one remedy advised is that of an ingeniously rough and ready tallow cup. This is so far valuable that it is a possible remedy to boilers which have already been found to give trouble in priming. We are afraid, however, that the grease thus put into the boilers will be far from beneficial to them. Our other correspondent draws attention to the fact that boilers may be designed of sufficient size and limited heating surface as greatly to reduce the tendency to prime. There is no doubt that if a boiler gives trouble by priming it might possibly be entirely prevented by the removal of a certain number of the tubes, so as to give greater steam and water space, and a decreased energy of ebullition. This will, however, decrease the evaporative efficiency of the boiler, and be therefore, to some extent, a drawback, though we do not think the efficiency would be much impaired, compared with what was effected whilst priming. Many different baffled exit pipes have been introduced, and suggested as a means of preventing priming on the basis that the water is whirled up by the steam and carried with it something after the manner of a water spout rising from the sea. It is difficult to decide in what way priming arises, or may be best prevented. We have heard of cases of iron vessels with twin boilers, one of which was a perfectly dry steamer, and the other primed dreadfully and incessantly. We have heard also of boilers which have primed badly for months and years, and then have ceased entirely, producing dry steam with certainty. Again, why should a boiler prime when new and leave off after a few week's work, This cannot be owing to design. We shall be glad to have further opinions and information on the subject from any of our practical readers.

THE simultaneous experiments by Sir W. Palliser and the Government as to the cause of the destruction of the 38-ton gun on board the Thunderer, are somewhat amusing, and attract a good deal of our attention. We think that both series of experiments prove without a doubt that the fact of an air space between the shot and the powder does not seem to have a bursting effect upon the barrel of a heavy gun, as the pressure per square inch is less with the air space than rammed home. It is, however, strange that an air space should be so injurious to a rifle, as we have known personally of cases of rupture of the rifle barrel produced by not having rammed the bullet home. We have also heard of a curious result produced by sand or dirt in the mouth of a barrel from which a bullet is being discharged. In such a case it is the invariable result that the barrel is split open at the muzzle where the dirt was lodged. It is difficult to conceive how such a trifling obstruction could produce such a destructive result. The explanation, we think, may be found in dynamic impact, and we should not be surprised to hear from further experiments that the destructive effect of the air space is much greater, should the shot be near the muzzle.

WE have been much interested in the incidents of the experimental trip of the yacht "Wanderer" which was fitted with engines on the Perkin's high pressure system. This yacht, the property of a wealthy private gentleman, Mr. C. J. Lambert, is 175ft. long, 29ft. beam, and 708 tons, builder's measurement. To adapt this yacht to the Perkins's system, a boiler of the well-known Perkins' type was fitted with 76 square feet of grate area, and working up to 400 lbs. per square inch pressure. The cylinders of the engines were three in number, 48 inches, 34 inches, and 17 inches in diameter respectively, the 17 inch cylinder standing on top of the 34 inch cylinder, both pistons working on the same rod. The steam admitted at 400 lbs. pressure per sq. in. on the 17 piston was then passed to the 34 inch cylinder direct, and from that to the steam chest of the 48 inch cylinder. The valves on the two smaller conjoined cylinders were poppet valves, but that in the steam chest of the 48 inch cylinder was an ordinary slide valve. There seems to be much dissension and difference of opinion as to the grounds on which the Perkins' engines are now being displaced by ordinary compounded engines of the usual type. There is no doubt that the large slide valve on the 48-in. cylinder was faulty. This valve was found to be cracked all over, and the port faces to spring out of shape so as to make the valve blow through. It does not seem certain whether this valve was ever effectively put right or not. Another point causing great trouble was the leakage of water, at the pump-gland in particular, which was of such amount that it is stated that the distilled water from the supply tanks was being used as fast as the coal. In coming home also, the temperature of the stoke-hole seems to have been unbearable, and the high temperature of steam at 400 lbs. seems to have been sufficient to char, and set fire to a wooden bulk-head. These are all very grave defects in the system as applied, but we cannot but think that they might one and all have been avoided by suitable means. Whether these means were neglected by haste in getting to sea, or by oversight in the designers or builders of the engines is not very clear. With regard to leakage at the pumps, a short stroke slow pump can be packed much tighter than a high speed long stroke pump, such as that fitted on board the Wanderer. The slide valve, if found liable to fracture or bad wear, might be easily substituted for by the poppet valves which worked so successfully in the other cylinders. A stoke-hole may be kept cool in spite of high temperature of boiler, by suitable non-conducting material and proper ventilation. In the same way such a non-conductor as slag wool or felt would ensure perfect isolation to the boilers or flues, from any timber bulk-heads or beams likely to char. We are of opinion, therefore, that the result of the trip of the "Wanderer" is more a proof of carelessness in the management and fitting of the engines, or of undue haste, and neglect of proper attention to details in putting to sea, rather than any substantial evidence against the suitability of the Perkins' system to yachts and other sea-going steamers.

WE hear that a torpedo boat of a distinctly new design has arrived at Portsmouth from the Thames, where it has been built and engined by Messrs. Maudslay, Sons and Field. It is 86ft. long and 11ft. 6in. beam, and has a displacement of 28 tons. The principal novelty about her, is that she is built entirely of manganese bronze, by which it is expected that she will be entirely free from corrosion. Her skin is only [illegible] of an inch thick, which is scarcely sufficiently strong to give her the necessary rigidity and stiffness, as she vibrates very much when under way. We think it rather strange that iron and steel should not be dipped in a suitable anti-rust or preservative compound before use in ship building. Anti-corrosion is evidently a condition much to be desired in the hull of a vessel both inside and outside but we do not think that bronze is the most suitable material to effect that purpose. The rigidity of bronze is well known to be much less than that of iron and steel, and its costliness is much in excess of the latter. It should be by no means a difficult matter, to so impregnate the surface of the iron or steel plates, used for a vessel, with a suitable chemical, as to render them perfectly impervious to the after effect of rust. This may be seen from the fact, that rust is but an oxide of iron formed by the great affinity of oxygen for pure iron or steel. The action of salt water produces also the chloride of iron. Both these chemical re-actions might be prevented, by causing a preliminary chemical combination of the surface, iron or steel, so as to destroy any further affinity for oxygen or chlorine.

THE Board of Trade Surveyors seem to be making themselves considerably obnoxious just at present to the builders and owners of passenger steam ships. Of course t hereis no doubt, something to be said on both sides as there usually is, but at the same time those who act as public censors and inspectors in any department may be sure that they are exceeding their obvious duties, when the public at large, and those disinterested in the questions at issue stigmatise their conduct as unreasonable. The British public would be the first to cry out that they were supporting a costly and useless institution, did they deem that no sufficient duties were being carried out by their public officers. Again, in a matter of inspection and censorship such as that entrusted to the Board of Trade Surveyors, it is absolutely necessary to formulate with perhaps arbitrary harshness, what is to be considered correct by the inspecting officers and what is to be considered insufficient. The officers individually, must be bound by these rules, or there would be endless differences amongst the decisions of the various officers, and the approval of the Board and its certificate as at present issued, would lose all definiteness and value. A notable point in dispute at present, between the Board Surveyors and Messrs. R. Napier and Sons, is as to the non-efficiency or reliability of cast iron bends in large piping fitted in the passenger steamers Pizarro and Mendoza. Much heat is being displayed in this controversy, and even seems likely to terminate in a law-suit. We think that on the one hand it is rather an absurdity for public officers to be appointed with powers of inspection and censorship in the interest of passengers, before a formal certificate can be granted of efficiency, and then for such censorship to be questioned in law. Nor do we think it fair to abuse individual surveyors or the whole body, for adhering to rules which must be laid down for their guidance. But on the other hand we think, in this particular case the Board as an inspecting protecting body, has seriously compromised the value of its decisions. In the first case of the Pizarro, owing to the opposition of builders and owners, the cast iron elbow pipes were passed and the certificate finally granted, although at first refused. In the second case of the Mendoza, the certificate was again refused on account of the cast iron pipes and the refusal maintained. If the Board of Trade requre their opinions and certificate to be respected, their decisions should be maintained in face of all opposition, except that oftechnical evidence that their decisions are erroneous. In such case, an amendment of instructions to their surveyors should be at once frankly made, and acted upon in ensuing cases.

MESRRS. SIMONS & Co., Clyde shipbuilders, who have attained a world-wide reputation as constructors of dredging plant, have almost completed, and will launch in a day or two, a sewage steamer for the Corporation of Liverpool. It is believed that the municipal authorities of Liverpool will possess the first of a fleet of vessels that will materially assist in the disposal of sewage. The new vessel, which is named the *Liverpool*, resembles externally an ordinary steamer. The hull and the deck are built of iron, but in the construction of the hopper cavities steel is used. The vessel has been designed to carry a dead weight of 350 tons, and her speed will be nine knots an hour. Her arrangements for disposing of sewage and refuse are simple but effective, and differ from those in use in hopper barges. Instead of one large hold she has ten compartments or cavities, and these are perpendicular in shape, so as to admit of the contents falling readilly into the water. Along the centre of the line of cavities is a set of gearing, by which the doors at the bottom are opened and shut, and by means of strong iron rods the doors are kept open until all the refuse has been emptied, while, by reversing the action of the gearing, the compartments are closed again. The whole arrangements are well calculated to attain the object in view, and the experiment about to be made by the Corporation of Liverpool will be watched with interest by the municipal authorities of other large town.

STEAM STEERING GEAR OF H.M. SHIP CERBERUS, MELBOURNE.

The Cerberus on her arrival in Hobson's Bay was fitted with the ordinary steering gear, and the number of hands required to work this when the vessel was going at full speed, together with the difficulty of being able to port or starboard the helm quickly, so necessary in a man-of-war, induced the authorities to have special machinery designed for this purpose and substituted for the old gearing. The matter was entrusted to Mr. Wilson, the Government Inspector of Machinery, Victoria, and he has designed a very complete apparatus, the particulars of which we are now able to lay before our readers. On the lower or shield deck, near the turret, are placed a pair of horizontal engines, the cylinders being 13-in. diameter, 15-in. stroke, placed 18-in. centre to centre; they are worked differently from ordinary engines, inasmuch as the valves are under the control of the man steering, and in no way connected to the engine. Placed over and on the top of each cylinder 14½-in. centres are two valves of the piston type, 14-in. long by 6-in. diameter, the steam passing through the centre of the valve and the exhaust on the outside of it through a groove 9-in. long by 1-in. deep; each end of the valve has a bearing of 2½-in. with a packing spring let in to keep it steam-tight; a short valve spindle passes through the valve and casing, and is attached to an excentric rod 4-ft. long—passing over and in front of the cranks—from whence rise standards having a horizontal shaft fixed thereto to receive the eccentric; in front of this shaft, connected by two bevel wheels, the steering wheel is placed. The slightest move of this wheel gives a corresponding travel to the engine. After the wheel has had a sufficient number of revolutions to port or starboard the rudder, it stops by means of a nut placed on the spindle of the wheel, which travels on it, enlosed in a box cast on the standard of the required length. This prevents the steersman overrunning the engines, and as there is a pointer fixed on it, it serves to show the position of the rudder at any time. The bed or sole plate on which the engines are fixed is of cast iron, moulded to the deck of the ship, and shaped in a manner to receive a heavy thrust block bolted to it; this thrust block is placed close and in line with the crank shaft, it is 13-in. long by 8½-in. diameter, fitted with six grooves; 3-ft. from this, and in a line with it and the crank-shaft, a large oil cylinder is placed, 3-ft. 6-in. long by 1·7½ internal diameter, with metal 4½ thick; this cylinder is strongly bolted to the iron deck and beams of the ship with 1½ bolts; through it and its covers passes a hollow trunk with piston cast thereon; its length is 7-ft., with a diameter of 14-in. and a thickness of metal of 2½-in. The piston is 3-in. thick, having a leather washer on each side with an iron ring to keep them in place; through the trunk passes a large screw 4-ft. long, 7½-in diameter, 1½-in. pitch, with square threads working in a brass nut 12-in. long, which is firmly keyed and secured to the end of the trunk nearest the engine, and slides on two guide rods, the ends of which are secured to the thrust block on one side and the front cone of the oil cylinder on the other, the screw being attached to the crank-shaft by means of couplings. It will be seen that as the engine is worked the trunk and pistons will be moved through the oil cylinder to port or starboard as the engines may be worked. The large cylinder above described is filled with oil, and has 1¼-in. hole cast in the hollow at each end of cylinder; to these holes are attached pipes of the same diameter running underneath the deck to a distance of 66-ft. or thereabouts; these pipes are connected by two hydraulic rams, one on the port and the other on the starboard side of the tiller-head, bolted underneath the iron deck and perfectly protected from an enemy's fire. The length of the ram's cylinder is 6ft., having an outside diameter of 15¼-in.; the ram is 9$\frac{11}{16}$-in. diameter, with 2½-in metal; the two rams are connected together by a heavy wrought-iron crosshead, about 20-in. diameter, in the centre of which is a large nut working on two pins into the crosshead; the internal diameter of the nut is 9-in., it is 12-in. long, and has a brass bush fitted inside in which the tiller slides. As the rams are moved from port to starboard or *vice versa* in a direct line, the nut working in the crosshead takes the angle of the tiller, the greatest angle of its travel being 45 deg.; each of these rams is filled with oil, as is also the main cylinder after its piston has been placed in mid-gear; the slightest move, therefore, on the part of the engine, gives motion to the tiller, while the oil acts as a cushion to relieve any shocks which might otherwise be thrown on the machinery. The whole weight of the machinery is about 9 tons, and reflects considerable credit, not only on the designer, but also on the contractor, Mr. Thos, Tozer, of the Vulcan Foundry, Melbourne,—*The Australian Engineering and Building News.*

ONLLWYN AND DULAIS COLLIERIES.

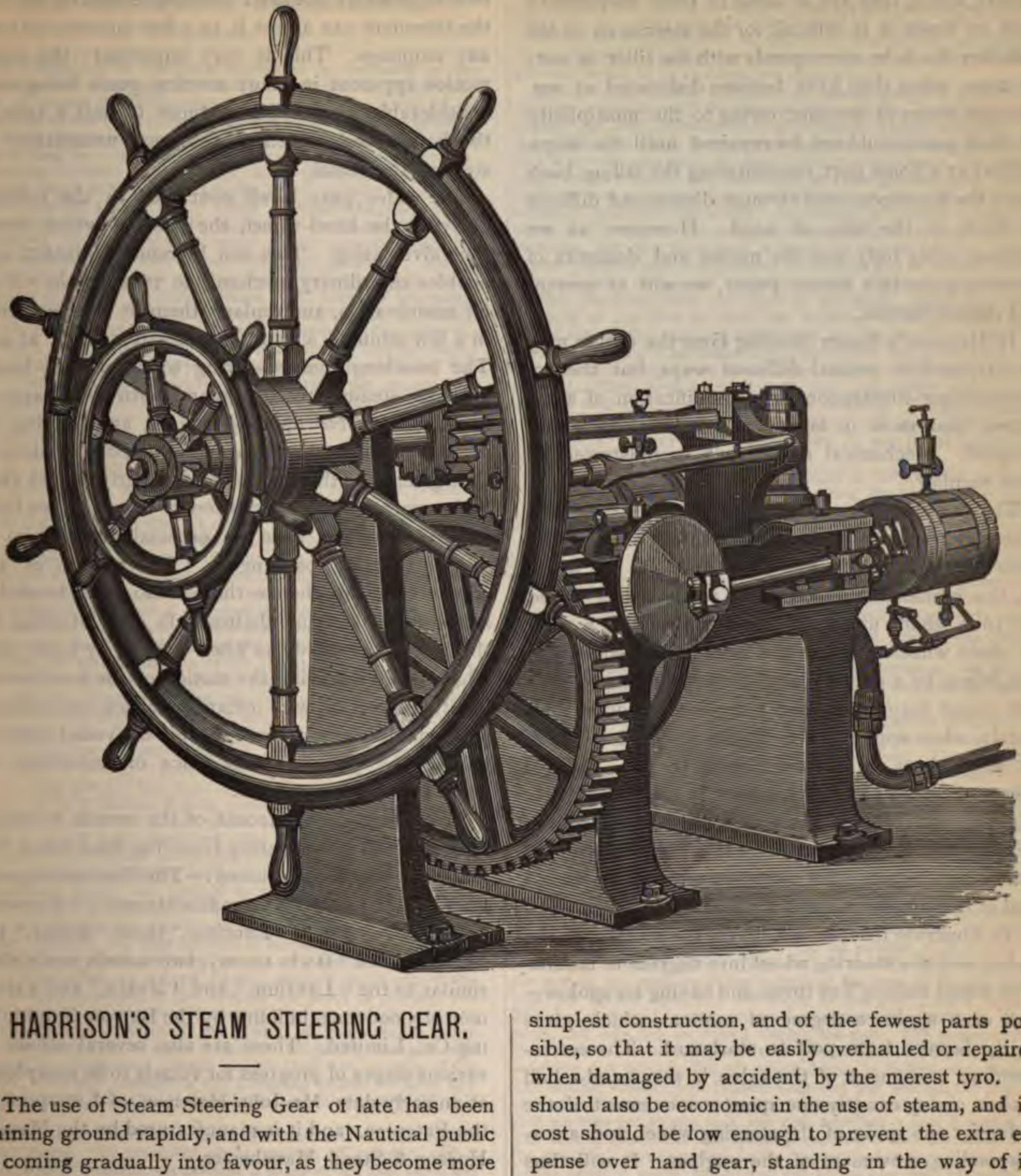
We are glad to see that coal is likely to participate in the general revival of trade. This is an undoubted result of the increased demand for shipping as freights become more numerous. There is also no doubt that steam power is likely to largely increase compared with sailing vessels.

One sign of such revival is generally an increase in the number of joint stock undertakings that are brought before the public at such a time. There is a good deal to be said for the prospects of any undertaking introduced and put forward immediately following such a period of depression as that we have passed through. First, any property is now likely to be bought at the lowest possible price and at the best possible terms for the purchasers. All the estimates of cost and estimates of selling prices must be at the lowest possible figure, owing to depressed markets. Therefore, any rise in value of the products which may now be reasonably expected all round, will be all to the advantage of such an undertaking, commencing operations at this period. It is curious how little the very important principle is understood amongst the general public, of investing when markets are slackest and holding their hands when the markets are at the highest.

We notice that shares in a very good anthracite colliery in the County of Glamorgan, called the Onllwyn and Dulais Collieries are being offered to the public in our advertisement columns. As coal is a subject of great importance to our readers who may be ship owners, we think we shall be doing them a service in drawing their attention to such undertakings. Of course, we can know nothing personally of such property except from the report of the Engineer W. J. O. Jones of Swansea, who is well-known to us and others. However, we would wish to direct attention to the broad facts that investments should as a rule be made at the lowest depression of a market, just before a rise, and further that hedging risks is a safe rule for investment for ship owners as for others. If rising prices in coal will affect shipping profits, this may be covered by investment in such mineral properties profiting thereby. The output mentioned in the prospectus is very low, only 200 tons per day as a basis for their profits. This output, with increased briskness, ought to be much greater in a short time. A very praiseworthy and *bonâ fide* feature about this undertaking is, that the Directors themselves subscribe for nearly ⅓ of the present issue of capital.

NARROW ESCAPE OF A STEAMER.

There has been a good deal of public discussion about the disaster to the *Eldorado*, belonging to the British India Steam Navigation Co. The public accounts seem to indicate a most deplorable want of pluck and stamina amongst the crew of sixty Lascars, and to attribute the saving of the ship almost entirely to the efforts of the English officers and passengers, We see that this has been partially contradicted by the captain and others, but we fear that the anxiety for the credit of the line has somewhat influenced the latter representation. The *Eldorado* outward bound met a severe hurricane in the Bay of Biscay where it was found necessary to take all sail in and batten down the hatches. By the carrying away of one of the ventilating shafts the water poured down into the engine-room and stokehole. As it accumulated the fires were put out, the vessel lying helpless in the trough of the sea. The passengers then manfully set to work bailing with buckets and after about twenty-four hours it was found possible to relight the fires. The steamer was thus brought again under command and returned to Plymouth for repairs. This is another instance pointing to the immense advantage and increase of safety which would accrue to large steam vessels by being fitted with independent pumping engines such as the centrifugal pumping engines of Messrs. J. & H. Gwynne, as fitted on board the *Gallia*, &c., which would prevent the possibility of the boiler fires being extinguished. It is pitiable to think that with all the immense mechanical appliances at the command of steam ship owners that so large a steam ship should be so easily disabled and reduced to bailing out with buckets in order to keep the vessel afloat. We are glad to hear, however, that the Peninsular & Oriental Steam Ship Co. and other large companies, are fitting Messrs. J. & H. Gwynne's centrifugal pumping engines to their fleet and it is to be hoped that all steam ship owners will no longer leave passenger or cargo steamers unprovided with such an ordinary precaution against being swamped by heavy seas.



HARRISON'S STEAM STEERING GEAR.

The use of Steam Steering Gear of late has been gaining ground rapidly, and with the Nautical public is coming gradually into favour, as they become more confident in the reliability and dependence which can be placed upon a good gear, in rapidly handling a vessel at sea. It is of great importance that such a gear should be of the most perfect description, as the safety of the ship depends materially upon the rudder, and its easy and certain manipulation at all times. In addition—in a steering gear actuated by power– to its reliability, it should also be of the simplest construction, and of the fewest parts possible, so that it may be easily overhauled or repaired when damaged by accident, by the merest tyro. It should also be economic in the use of steam, and its cost should be low enough to prevent the extra expense over hand gear, standing in the way of its universal introduction as a helpmeet to those who have to work, and navigate the ships of our Mercantile Marine, through all kinds of weather and insuperable difficulties. There are many Steam Steering Gears now in use, most of them have one or other of the above faults: some, for instance, use so much steam that one of the main boilers has to be delegated off entirely to supply steam to steer the ship; in others, again, they are so loose in their movements, that at times it is difficult for the steersman to tell whether the helm corresponds with the tiller or not; in some, when they have become dislocated at sea through stress of weather, owing to the multiplicity of their parts could not be repaired until the ships arrival at a home port, necessitating the falling back upon the hand gear, stiff through disuse, and difficult to work in the time of need. However, as we purpose going fully into the merits and demerits of steering gears in a future paper, we will at present not digress further.

In Harrison's Steam Steering Gear the design may be arranged in several different ways, but the accompanying illustration, or a modification of such, shows that most in favour, and as now generally adopted. Mechanical details will be illustrated in next number.

The steering engine is simple and compact. The cylinders are placed horizontally, and fitted with piston-valves in the usual manner. A worm on the crank shaft gears into a worm wheel keyed on to a shaft underneath, which carries a pair of chain wheels. These are loose on the shaft, and are driven by a clutch placed between them, so that the vessel may be steered with either rudder altenately, when applied to a double ended boat, such as ferry boats, or boats for river traffic. This, of course, in ocean going steamers is dispensed with. On the end of this shaft is a small bevil pinion gearing into a wheel, keyed on to a vertical spindle, passing up between the cylinders, and on the forked end of this spindle is fitted a cut-off valve.

To illustrate this we will divide the motion of the valve, and the steering wheel into degrees of motion. The wheel making five turns, and having six spokes—call each spoke a degree of motion—which gives thirty degrees from port to starboard. The corresponding movement of the valve is seven-and-a half inches, giving exactly one quarter movement of the valve for one spoke of the steering wheel, and a corresponding movement of the engines. It will thus be clearly evident that this gives a great advantage over other steering gears, where the travel is frequently less than half of this. The controlling valve being directly attached to the vertical spindle does away with the wear and tear, of levers, pins, &c., and precludes the possibility of slack motion in the steering wheel. The wear of the worm and wheel on the valve-gear is compensated for, by making the bushes in which the shaft revolves, eccentric, so that the attendant can adjust it, in a few minutes without any stoppage. This is very important; the slack motion apparent in many steering gears being very considerable, amounting at times to half a turn of the hand-wheel, which causes great uncertainty in steering the vessel.

The valve gear is all contained in the column carrying the hand-wheel, the base of which forms the valve-casing. This can be removed intact, and enables an ordinary mechanic to take out the valves for examination, and replace them in working order in a few minutes, a great consideration when at sea. The knocking sounds—owing to throttling—heard in most steam steering gears, entirely disappear in this the valve opening so far, and closing so rapidly completely prevents anything of the kind, so that given that the engines are properly looked after with respect to the lubrication of bearings, we have a perfectly silent gear, an especial disideratum in vessels carrying passengers. The motion of the engine is steady, hence there is no shock or undue strain on the steering-chains, rods, &c. Steering by this gear is as steady as when steering by hand only. The engines following the motion of the hand-wheel in either direction with instant precision and submission, enabling any seaman to steer the vessel without having had previous experience or knowledge of gears controlled by steam.

Amongst the most recent of the vessels to which Harrison's Steam Steering Gear has been fitted, the following may be mentioned :—The four-screw goods ferry boat, "Oxton," the paddle steamers "Primrose and "Daisy," the ss "Laurium," the ss "Mokta," the "Game Cock" (twin screw), two vessels unfinished similar to the "Laurium" and "Mokta," and a steamer of 3,000 tons, building by the Barrow Shipbuilding Co., Limited. There are also several others in various stages of progress for vessels to be completed at an early date, Mr. John Harrison, of Liverpool, is the Patentee, and it is manufactured by the Messrs. Hodson & Stead, Manchester.

DR. PATTERSON, of the British Seamen's Hospital, Galata, states that firemen and stokers, as a class, become ruined in health at an early age. Heart disease, glanular and kidney disease are quickly developed in them, and this, probably, is due in a great measure to the fact that the function of the skin is almost entirely suppressed under ordinary conditions of temperature. It is clearly demonstrated that this condition is due to imperfect ventilation.

THE THUNDERER EXPERIMENTS.

The Committee of Ordnance appointed in reference to the bursting of the 38-ton gun at the commencement of the present year, on board the Thunderer, have conducted a series of experiments on the companion gun to that which suffered explosion. The scene of operation was the proof-butts attached to Woolwich Arsenal, and the whole of the Committee were present, comprising Major General Gordon, C.B., R.A. (president); Rear Admiral H. Boys, R.N.; Colonel Inglis, R.E.; Colonel MacFarlan, R.E.; Colonel Owen, R.A.; Lieut. Colonel Maitland, R.A.; Captain Cyprian Bridge, R.N.; and Major C. Fairfax Ellis, R.A. (secretary). Captain Morley, proof officer, superintended the firing operations, and took the velocities and pressures. Among the officials and visitors present were—Colonel Noble, R.E., Inspector of Works; Captain O'Brien, R.E., Assistant Inspector; Captain Elsdale, R.E., Captain Templer, and Mr. R. S. Fraser. A preliminary round had been fired on the previous day, when the gun was loaded with 85 pounds of pebble powder, and an empty common shell weighing 587 pounds, including the gas-check. The muzzle velocity of the projectile was 1418 feet per second, and the pressure at the bottom of the bore 20.2 tons per square inch, the recoil of the gun up the incline being 3ft. 8in. The shell buried itself deep in the mound.

The first round consisted of 110 pounds of pebble powder and an empty Palliser shell of 704 pounds, the muzzle velocity was 1408 feet per second, and the recoil 4ft 1in, The pressure at the bottom of the bore was 21.8 tons per square inch, and on the base of the shell 18.1 tons. This round, and the one with common shell on the previous day, served to afford a standard for the succeeding rounds in respect to the pressure set up. There was nothing abnormal in the conditions observed thus far, except that the charge was in each instance crammed home hard, to correspond with what is supposed to have taken place on board the Thunderer. It may be noticed that these two charges represented what were considered by the Thunderer Committee to have been the actual contents of the gun at the time it exploded, except that on the fatal occasion the 110lb. charge and the Palliser projectile was placed in the gun prior to the introduction of the 85-pound charge and the common shell. The disastrous result attributed to the double-loading is not a mere question of the weight of powder and shot employed, but depends essentially on the fact of a perfect "double-loading," and the extraordinary position thus given to the front cartridge, which was entirely in advance of the trunnions, having powder and shot behind it, as well as a shot in front. Under these circumstances it is generally believed, or at least suspected, that the front cartridge was crushed into a condition of extreme density by the impact of the hindmost shot (the Palliser) before it underwent ignition. Such compression would add greatly to the explosive effect of the powder, and this, combined with the fact that the cartridge occupied a place in the gun which was never designed to do duty as a powder chamber, has been deemed to account for the violent disruption of a very strongly-built gun. As an instance of what a gun of this description can endure, we may mention that a gun of the same weight, employed at the Arsenal for proof of powder, has fired seventy-eight rounds with service charges, and as many as 226 rounds with charges of 200 pounds of P2 powder, a heavy projectile being used in each instance. Originally the gun was intended to receive no heavier charge than 110 pounds of P2 powder, yet it has undergone the foregoing ordeal without any further damage than the scoring of the steel tube with which it is lined.

The second round marked the commencement of the experimental series. It consisted of 85 pounds of powder, and a common shell weighing 591 pounds, a space of one foot being left between the front of the cartridge and the base of the shot. There was a time, not very remote, when such an arrangement would have been thought highly detrimental to the safety of the gun. Such an idea, however, does not now prevail at the Royal Gun Factories, nor at Elswick. The gun thus loaded was fired, as in all the rounds, by means of an electric circuit, the gun itself being enclosed in a massive "bursting cell" built up of earth and timber. The muzzle velocity was 1280 feet per second, and the recoil 3 feet 5 inches. The pressure at the bottom of the bore was 12.4 tons per square inch, and at the base of the shot 10.8 tons. In the final round for the day the space between the shot and the cartridge was again one foot; but in this instance the charge was 110 pounds of pebble powder and a Palliser projectile of 701 pounds. The muzzle velocity was 1310 feet per second, and the recoil 3ft. 1in. The day was now drawing to a close, and in the brief interval that remained all efforts to recover the projectile was inefectual. The pressure at the bottom of the bore of the gun was found to be 15.2 tons per square inch.

In all these rounds the gun was loaded precisely after the manner in which would be adopted on board the Thunderer, including the hard ramming which is known to have occurred on the occasion to which the experiments relate. The same description of powder was used, the same pattern of gas-check, the same kind of papier mache wad, and even the same rammer head, only the latter was propelled by a party of stalwart men instead of by means of hydraulic machinery. According to present arrangements the Committee will go on increasing the interval between the cartridge and the shot until a space of several feet has been reached, after which it is intended to load the gun in the ordinary way and to set up a jamb. Finally the gun will receive a double loading, presuming that the jamb is not fatal. Supposing the jamming of the shot to cause the bursting of the gun it by no means follows that the gun might not also be burst by double loading. It should be further understood that the 38-ton guns of the Thunderer were not chambered, neither were they polygrooved. They fired studded shot, and were rifled with nine grooves, each shot having three rows of studs. The gas-checks also were of the smooth-edged description. All these conditions reappear in respect to the gun which is now in the hands of General Gordon's Committee.

The projectiles fired from the gun being of the regular service form, with the ogival head, instead of being flat-headed like the proof-shot usually explode in the trials and experiments at Woolwich, the course of the projectiles after entering the great mound of sand enclosed witn timber is apt to be very erratic. Care has been taken to prevent the escape of any of these eccentric projectiles, and the result showed that the arrangements made were alike necessary and effective. In respect to the gun, it did not show any signs of damage. Concerning the wads, we may observe that, although they were stout and strong, they appeared to break up into very small pieces.

On resumption of the trials at a following occasion, two projectiles which had remained unrecovered had in the interval been dug out.

In each instance the ogival-headed shell had curved downward through the sand and burried itself in the clay foundation, one going 8 feet deep in the clay, and the other 5 feet. Throughout the trials the powder is the same that was used on board the Thunderer, being the P powder, consisting of cubes about three-quarters of an inch thick. In all cases the charge was rammed home hard, whether without an air space or with one, and each projectile was fitted with a gas-check. Subsequent to the experiments of last week the vent of the gun had undergone repair, the effect of which was simply to prevent the powder gas from getting between the steel lining of the gun and the super-imposed coil.

In the first two rounds fired before the space between the front of the cartridge and the base of the shot was two feet. In the first round the charge consisted of 85lb. of powder, with a common shell weighing 586lb. The muzzle velocity was 1174 feet per second, the pressure at the bottom of the bore of the gun 9.9 tons per square inch, and the recoil of the gun 3 feet 1 inch. The shot appeared to have pursued a downward course in the butts, and was not recovered during the day. The companion round consisted of 110 pounds of powder and a Palliser shell weighing 698 pounds, the air space being as before—two feet. The muzzle velocity now became 1223 feet per second, the pressure at the bottom of the bore 12.7 tons, and at the base of the shot 9.9 tons per square inch, the gun recoiling 3 feet 8 inches. The shot in this round was speedily recovered, and the state of the gas-check corresponded to the moderate pressure indicated by the crusher guage, the copper rim not having fully expanded into the rifling of the gun,

In the next two rounds the space between the cartridge and the shot was increased to 4 feet. With 85 pounds of powder and a common shell weighing 586 pounds the muzzle velocity fell to 941 feet per second, the pressure at the bottom of the bore being as little as 4 tons per square inch, the gun recoiling 2 feet 8 inches. The projectile, like the first one of the day, burried itself beyond immediate recovery. In the next round the air space continued at four feet, with a charge of 110 pounds of powder, and a Palliser shell weighing 705 pounds. In this round the point of the shot was less than a foot from the second shoulder of the gun. The whole length of the bore is sixteen feet six inches, and the point of the shot would be a few inches more than half way between the bottom of the bore and the mount of the gun. The muzzle velocity in this round was 1013 feet per second, the pressure at the bottom of the bore 12.6 tons per square inch, and at the base of the shot 8.9 tons per square inch, the gun recoiling 3 feet 4 inches.

In the next pair of rounds the air space was increased to six feet. Commencing with 85 pounds of powder, and a common shell of 592 ponnds, the velocity of the projectile was as little as 780 feet per second, and pressure fell in a most marked degree, being only 2·2 tons at the bottom of the bore, and 1·7 tons at the base of the shot, per square inch. The gun recoiled 2 feet 3 inches. So low was the pressure that the gas-check took no impression from the rifling. The next round was with 110 pounds of powder and a Palliser projectile, weighing 705 pounds. The intervening space of 6 feet brought the point of the projectile to a distance of about 11 feet from the bottom of the bore, and therefore about 5½ feet from the muzzle. The velocity in this round was 876 feet per second, the pressure at the bottom of the bore being 8·9 tons, and at the base of the shot 6·4 tons per square inch, the gun recoiling three feet two inches. In each of these last two rounds the projectile on entering the butts speedily flew up from beneath the sand, and struck the underslde of the roof, damaging a boiler plate. In the last round the shot dislodged some of the concrete with which the roof was protected. But the construction of the bay into which the shots were fired was extremely good, and all the arrangements connected with it were thoroughly satisfactory.

The firing of these six rounds constituted a very good day's work, and as night was coming on the firing ceased. The results, so far, may be pronounced extremely satisfactory, showing that the accidental slipping forward of a projectile in a 38-ton gun to the extent of six feet involves no danger to men who may be working it. Neither does it appear that any damage is likely to accrue to the weapon itself. Of course it is premature to estimate with certainty what may be the effect of still greater air spaces, but there is nothing yet to indicate that any injurious pressure will be set up, though it must be observed that the pressure in the immediate rare of the shot is now taking effect on a comparatively weak part of the gun. On the completion of the air space experiments the Committee will most likely proceed with that part of their programme which relates to the possibility of the shot being jammed by a wad. The grand trial of the double loading is reserved to the last. The value of the gun is about £3,000.

The firing was again resumed on the following day, but not until the afternoon.

The damage done to the roof of the butts by the operations of the previous day having rendered some repairs necessary, so as to preclude any risk of a glancing projectile escaping out of bounds. While this part of the work was being performed under the superintendence of the officers of the Works Department, a careful examination of the gun was being carried out at the instance of General Gordon's Committee, the bore was gauged to the thousandth of inch, and no sign of any damage or overstraining could be detected, except that in the vicinity of the powder chamber there was an extremely slight variation, such as might be accounted for by the clearing away of a film of rust.

The firing on Monday terminated with two rounds, in each of which a space of six feet was left between the front of the cartridge and the base of shot. Yesterday the experiments commenced with an intervening space of eight feet, With a Palliser projectile and a battering charge, this brought the point of the shot up to within four feet of the mouth of the gun. With a common shell, and what is called a "full charge," the distance from the muzzle would be about three inches more. The latter description of round was fired first, consisting of 85 lbs. of pebble powder and a projectile weighing 532 pounds. The muzzle velocity showed a still further reduction compared with previous rounds, being only 664 feet per second, the pressure at the bottom of the bore being also small, not exceeding a ton and half on the square inch. The gun recoiled with its carriage on the slide to a distance of two feet. The shot went deep in the sand of the buts, and was not recovered during the day. In the next round, 110 rounds of power were used, and a Palliser shell weighing 701 pounds. As on former occasions, the increased charge of powder more than compensated for the extra weight of the shot, and the velocity rose to 754 feet per second. The pressure also became augmented, being 7.4 tons per square inch on the bottom of the bore, 5.4 tons at the base of the shot, the gun recoiling 2 feet 10 inches.

A fog which had been investing the scene with a considerable amount of gloom now threatened to stop all further experiments, but it was resolved to proceed if possible, and a light was fixed at the butts to facilitate the laying of the gun. It was suggested by Colonel Noble, the Inspector of Works, that it would be well to fire the next two rounds in reversed order, giving the Palliser precedence over the common shell, so that the slower projectile should follow the faster one, thereby enabling the second shot to be fired without risk of striking its predecessors, should the first one happen to bury itself deep in the sand. This suggestion was adopted by the Committee, and consequently the next round became the most important of the entire series. The charge was 110 pounds of pebble powder, with a Palliser shell weighing 698 pounds. Between the powder and the shot intervened a space of no less than ten feet, thereby bringing the point of the shot so near the muzzle of the gun that it was within arm's length, the distance down the bore being only 21½ inches. The result of this round was awaited with some curiosity, the behaviour of the projectile on its way to the butts being open to some doubts. The muzzle velocity proved to be 582 feet per second, and the pressure at the bottom of the bore 6.2 tons per square inch, the gun recoiling 2 feet 5 inches. Tho projectile made a fair flight, but on entering the butts it turned downward and burried itself beyond immediate recovery. The fog now slightly abated, and it was resolved to proceed with the final round, but the vapour soon gathered again, and a powerful light had to be shown at the butts in order for accurate aim to be taken. The charge now consisted of 85 pounds of powder, and a common shell weighing 595 pounds. Under these conditions the muzzle velocity fell to its lowest, being 536 feet per second, and the pressure at the base of the bore was rediculously small, being only half a ton per square inch. The shot struck low, and buried itself, so that the crusher gauge showing the pressure on the base of the shot was not recovered. The recoil of the gun was 1 foot 5 inches. Notwithstanding the low velocity of the projectile, and the small amount of pressure, the report was a loud one, and the concussion so shook the instrument room where Captain Moorley was making his observations, that the gaslights were immediately extinguished, and the swinging windows were blown open. The intervening distance might be about 150 yards, and the building was partly sheltered, but standing to the left front. It was noticed throughout the sereis of rounds that the interval of space between the powder and the shot appeared to have no effect in diminishing the loudness of the report. A slight diminution might perhaps have been detected, but certainly not the day before.

It is now evident, from a practical test which admits of no dispute, that the bursting of the gun on board the Thunderer could not have been caused by any slipping of the shot away from the cartridge. The next stage of the experiments consists in a series of rounds designed to show whether the bursting of the gun may have been caused by a wad getting out of its place and jamming the shot, the gun being otherwise loaded in the usual way. To test this theory it is intended, in the first instance, to place a wad in the bore five feet in advance of the shot, the wad being canted over so as to oppose an oblique surface to the impact of the ogival headed shell, the latter being empty. Other rounds will follow, with the wad placed at different distances. For the present, however, the experiments are in abeyance, and it is not likely that they will be resumed until after Christmas. Thus far the Committee may be congratulated on having made important progress, with decisive results, in a short period of time. Fourteen rounds have thus been fired, all except the first two having an interval of space between the cartridge and the shot.

Mr. T. L. K. Jamieson, recently a partner in the eminent Clyde shipping firm of John Elder & Co., intends to stand for the Northern Division of Lanarkshire, as member of Parliament in the Conservative interest.

The Duchess of Edinburgh is going to Scotland on purpose to christen the Czar's new steam yacht, now building at Messrs. Elder's yard, on the Clyde.

In the Common Pleas Division a case was heard in which an action was brought to recover £10,000 the value of a cargo lost in the vessel Kate. The plaintiffs contended that the cargo was lost through the Kate being unseaworthy, she having proceeded to sea *with a broken split pin in her cylinder*, which led to her being lost. A verdict was returned for the plaintiffs.

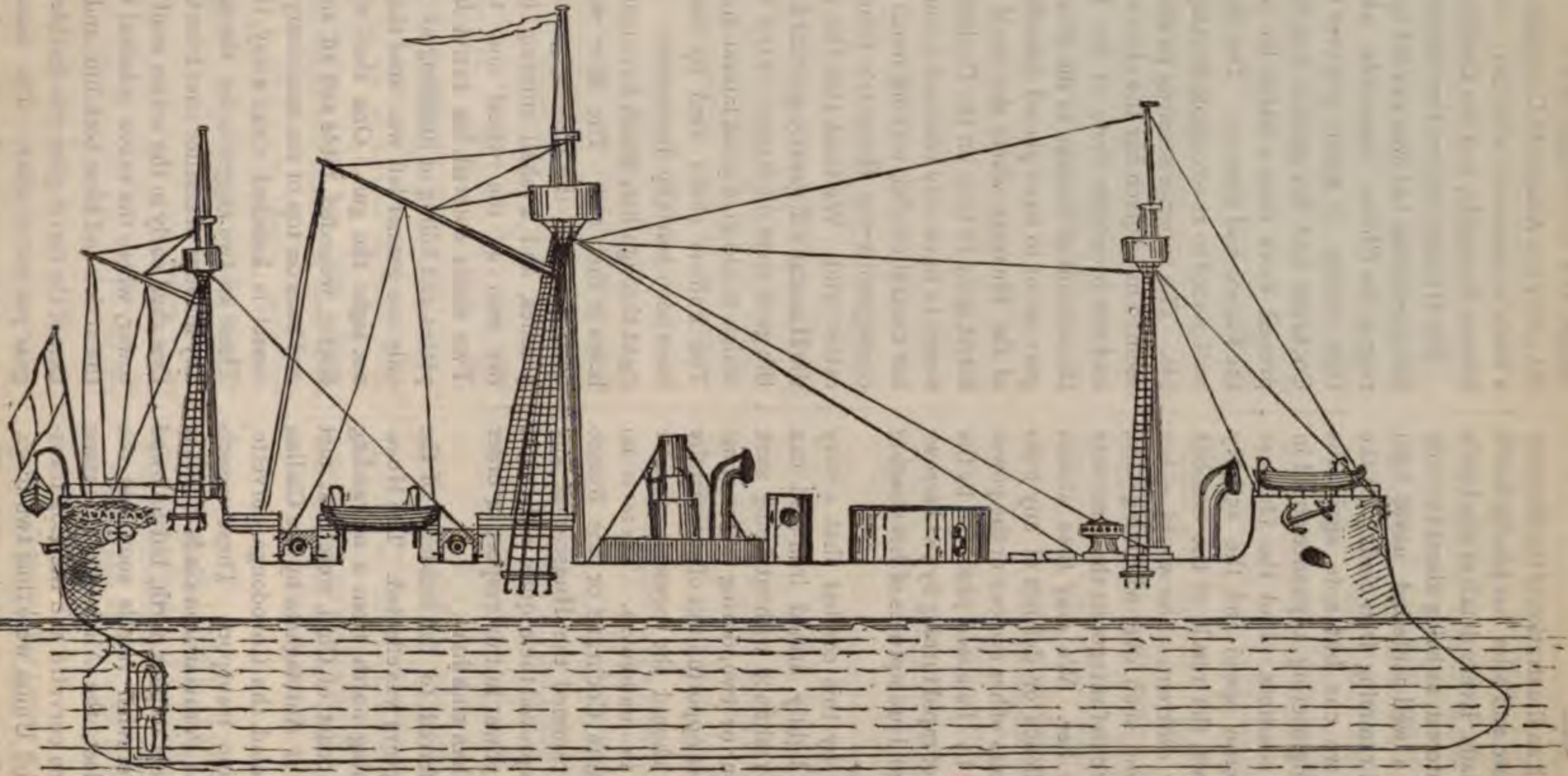
THE CAPTURE OF THE HUASCAR.

WE give this month an illustration of the Huascar iron-clad, before and after her plucky battle with the Chilian iron-clads. Every detail of this battle is, we think, of great interest, as being about the only instance we have of a well-contested naval fight between armoured and ramming iron-clads. In the result of this battle we can but note again the prominence that the engineering appliances hold in the deciding of such conflicts. Had the Huascar only possessed a superior speed and the activity conferred by twin-screws, the result of the combat might have been very different. She would either have got clear away from such over-whelming odds, or have soon settled her chief antagonist the Almirante Cochrane by ramming her. We may then almost guage the power for offence or defence of any iron-clad, not by the thickness of her armour or the power of her guns, but rather by the speed produced by the her engines, the power of rapid turning by twin screws and by the excellence and promptness of her steering gear.

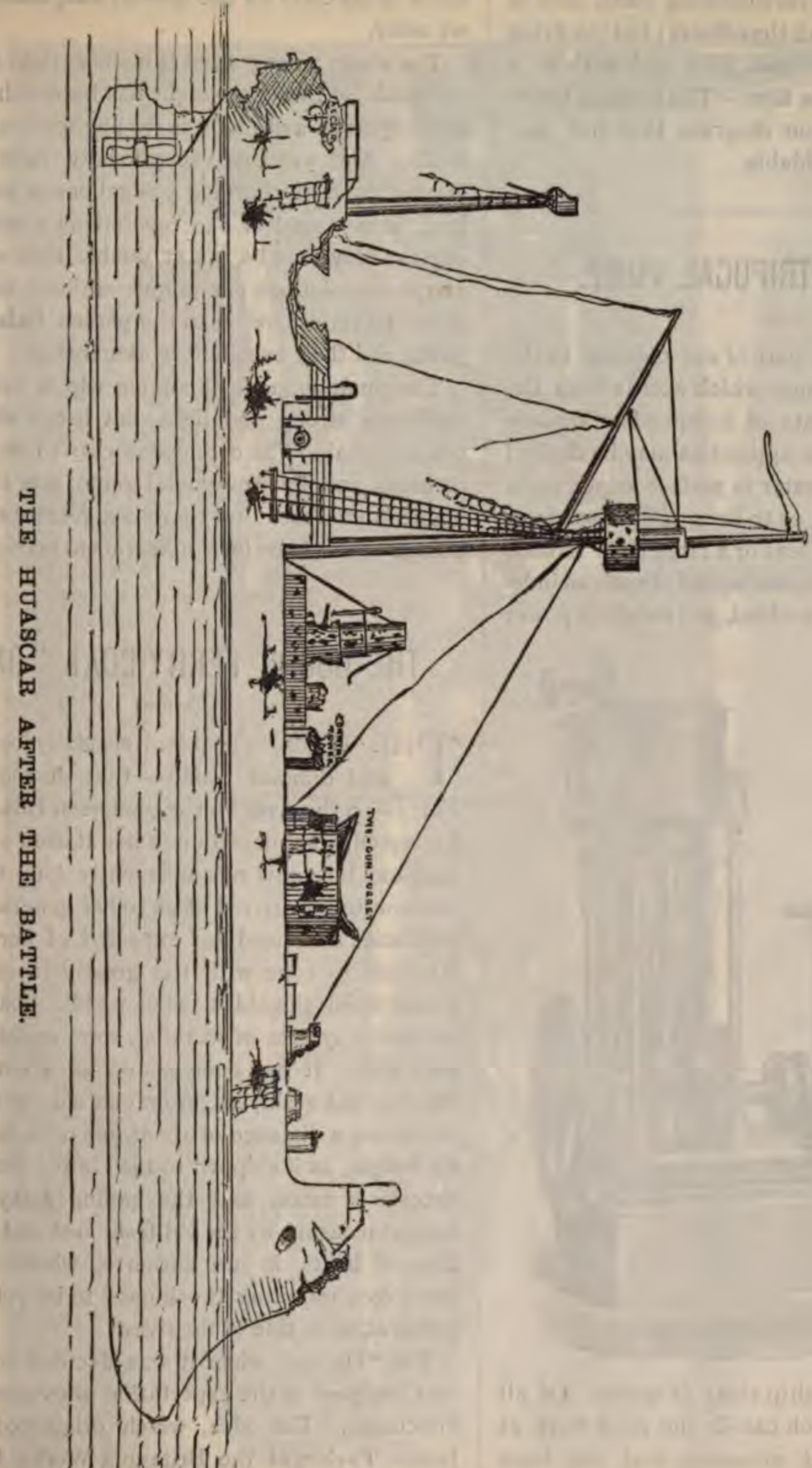
It is clearly proved by this combat that a very slight armoured and lightly armed iron-clad can maintain an obstinate resitance without being sunk or destroyed for an hour or two, during which time she may have numberless opportunities of successfully ramming her opponent should she possess superior speed and handiness in manœuvre. There is no doubt that the Almirante Cochrane or the Blanco Encalada might have rammed the Huascar at any time, but the result has proved them quite in the right to have reserved their power in this respect in order to capture her rather than sink her.

We have before referred to the incidents of the battle, and how the capture was effected. The Huascar and Union returning north from a marauding expedition down the coast of Chili were first met when leaving the Bay of Antofagasta by the Chilian Blanco Encalado iron-clad, the Covodonga corvette, and the Matias Cousino transport. These vessels not daring to attack the Peruvian iron-clads Huascar and Union, allowed them to pass north, but followed in their wake. The Peruvian vessels soon met the rest of the Chilian Fleet, the Almirante Cochrane iron-clad, the O'Higgins corvette and the Loa transport. The Huascar and Union were thus two to six, but endeavoured to make a running fight of it. The Huascar however found herself cut off, whilst the Union by her superior speed found herself able to escape, and accordingly did so. The Huascar was cut off by the Almirante Cochrane, and had to sustain a fierce engagement with her, soon assisted by the Blanco Encalado, and the Covodonga.

The Huascar several time ineffectually tried to ram her opponents, but was evaded by the rapid manœvring of the Chilian iron-clads, which are fitted with twin screws. It seems however that the Almirante Cochrane had her guns so well served that she had proved more than a match for her opponent before the Blanco had come up. The shots were extremely well placed so as to cripple the ship as much as possible. The superior steering powers of the Cochrane seem to have given her the choice of position, as she had fair broadside shots at the Huascar, and from the amount of damage to the after works and steering gear seems to have placed herself at the stern of the of the Huascar where she could not well bring her turret guns to bear on the Cochrane. The Cochrane seems to have only received a couple of shots outside her central citadel, without much damage to herself consequently the Huascar's firing must have been rather wild. We think that the revolving turret in the Huascar will greatly account for this, as is possible the guns were discharged as the turret came round which would give great lateral movement to the shot. The Palliser shells used by the Chilians seem to have been fearfully destructive. There are six shots right through her, which have made enormous jagged holes in their exit. The after works were partially destroyed and the steering gear was knocked away 3 times, and a shell entering her stern killed all the men at the wheel and the relief waiting. Two shells entered her turret blowing off the top plates and killing or disabling all inside. There was only one gunner left who fired the last shot, but could not sight the gun. One shell cleared the surgery, doctor, wounded, table and all, another sent wounded and beds on top of the machinery. The nose of the vessel is knocked clean away, the foremast is gone. There are two ragged holes through the funnel and any amount of smaller ones from the Nordenfelt guns. One shell early in the action went right in the conning tower, where the brave Admiral Grau was directing the action and blew both him and the tower to bits. One of the turret guns was disabled, and the revolving gear put out of order. The machinery and boilers seem to have escaped very wonderfully on the w hole as they have sustained no damage.



THE HUASCAR BEFORE THE BATTLE.

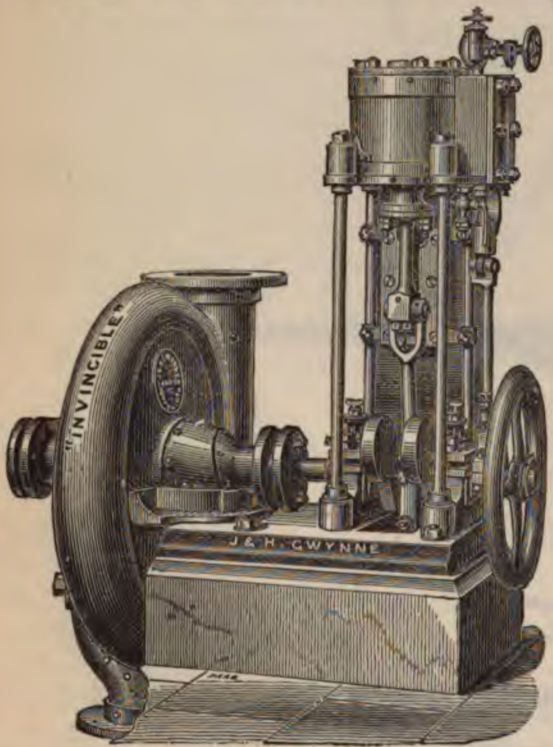

CONNING TOWER
TWO-GUN TURRET

THE HUASCAR AFTER THE BATTLE.

There is no doubt that the Huascar was most pluckily fought against overwhelming odds, and in the absence and death of all the officers; but the firing and fighting seem to have been wild and without a chance of success from the first. The damage to the vessel is so evident from our diagram that her surrender was plainly unavoidable.

GWYNNE'S CENTRIFUGAL PUMP.

WE refer in another part of our columns to the especial advantages which accrue from the adaption to all steam boats of independent donkey pumps, which can then be applied as may be desired to either circulating the water in surface condensers, to pumping out the bilge, or to keep the vessel from being swamped by heavy seas or a large leak. In such cases of emergency the normal speed of such an independent pump could be doubled, and its whole power applied to pumping the ship clear of water. Of all donkey pumps those which can do the most work at low lifts, with the most economy, and the least weights in material are the centrifugal pumps. The illustration we give of the "invincible" pump as designed and made by Messrs John and Henry Gywnne, of Hammersmith is, perhaps, one of the finest of its class for the special adaptation to which we refer.



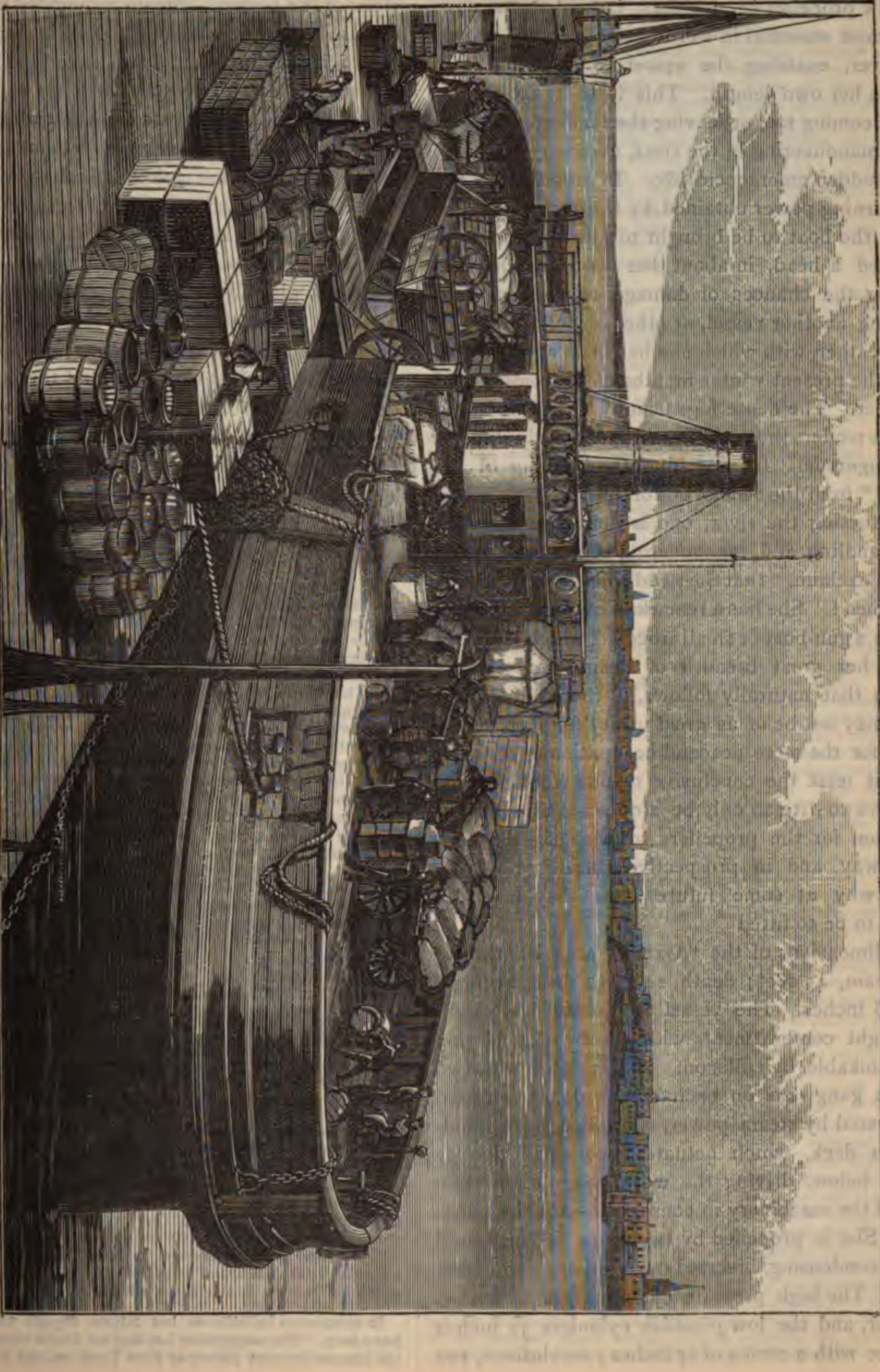
The whole arrangement is made as light as possible, so much so that its weight has been reduced to one and a quarter cwt., as it is for application to torpedo boats. And yet this exceptionally light apparatus is capable of discharging 500 gallons of water 30 feet high at a speed of 850 revolutions a minute. The engines may even be run at double that speed, viz., at 1700 revolutions per minute without the slightest jar or vibration, owing to the perfect balance of the parts, and their excellent workmanship.

The pump is made of copper which makes it exceedingly strong and light, but it can also be made of gun-metal. The cylinder is carried on four steel columns and the gun-metal guide acts as a tie rod. There is no doubt that there is a great future before pumps of this class for application to marine purposes.

THE GOODS FERRY-BOAT "OXTON."

THE "Oxton," a boat built specially for a particular and difficult traffic — that of the Woodside Ferry—on the river Mersey, between Birkenhead and Liverpool, was placed upon her station a short time ago, and has now run sufficiently long to enable a decision to be arrived at as to her general fitness for the duties advanced and expected of her. She was intended to cope with the greatly increased goods traffic which the old class of paddle boats, and the necessary system of working, were not able to compete with. It has been stated as a notorious fact that to send grain, &c., from one side of the river to the other, a distance of about one mile, cost as much for freight, as if shipped to the United States. These excessive rates, and the galling delay caused in a great measure by the old-fashioned and unsuitable class of boats in use hitherto, wheeled vehicles, carts, &c., requiring the horses to be yoked and unyoked at each side of the river.

The "Oxton," when it was decided to build her was designed in the expectation of overcoming these difficulties. The idea, which originated with Mr. James Taylor, of the Britannia Works, Birkenhead, the Chairman of the then Ferry Commissioners, to use four propellers, or double twin screws, that is two screws at each end of the vessel was adopted, or



LIVERPOOL FERRY BOAT "OXTON."

and which, is the principal engineering novelty in connection with the boat. This method of applying the screw propeller to steamers, is, we believe, new, and is most essential in a crowded and quick runing tidal river, enabling the vessel to be completely turned in her own length. This is of great importance in coming too, or leaving the landing stages, as well as manouvering in the river, avoiding collisions, and in sudden emergencies, &c. In addition to the quick turning power obtained, by the arrangement, it enables the boat to be brought to a dead stand, from full speed a-head, in about her own length, thus lessening the chances of damage on suddenly approaching another vessel, or other object, in thick or foggy weather, with which she has been amply tested during the present winter months of November and December. The dense fogs usually setting in about this time renders the cross traffic particularly difficult and dangerous. In watching the running of the "Oxton" from the deck of one of the passenger boats, when crossing the river, one is delighted with the ready handling and manouvering of the boat, and is ready to exclaim, "that the paddle boats for this work are doomed!" She has a remarkable likeness at a distance to a gun-boat or small ironclad, which is mainly due to her great breadth of beam; and it is a question that naturally follows, if the double twin screw, may not be of as great utility for purposes of war, as for the more peaceful occupation of carrying goods, at least the conclusive results would lead us to believe so; it can only be a question of sufficient immersion for the propellers, to keep them out of harms way, and in prospective there is no valid reason why at some future time they may not become to be so fitted.

The dimensions of the "Oxton" are—length, 130 feet; beam, 45 feet; depth, 14 feet; draft average, 7 feet 6 inches. The vessel is divided into eight water-tight compartments with a view of rendering her unsinkable by collision. She is fitted with two carriage gangways on each side, which are raised and lowered by steam power, controlled by a hand-lever on deck, which actuates two small donkey engines below, driving the worm-gear and friction cones of the machinery in connection with the gangways. She is propelled by two pairs, of compound surface condensing, inverted cylinder, engines, direct acting. The high pressure cylinders are 19 inches diameter, and the low-pressure cylinders 32 inches diameter, with a stroke of 24 inches; revolutions, 100 per minute; steam pressure, 65 lbs. The shafts run the whole length of the ship, passing under the sides of the boilers. Steam is supplied by two cylindrical multitubular boilers, 10 feet in diameter, by 10 feet 6 inches in length; two fires in each, having 6 feet by 3 feet. The boilers have a superheater attached, to which are fitted Cockburn's patent spring safety valves. The screw propellers are right and left-handed, and are 7 feet 4 inches in diameter, 13 feet 6 inches pitch, and have three blades. Each pair of engines is fitted with steam starting gear, and also hand gear worked from the deck. The vessel is also fitted with Harison's Patent Steam Steering Gear. In fact, the vessel is fitted throughout with all the latest and most approved appliances necessary to a first-class job, and the nature of the duties require of her. The "Oxton" was designed by Mr. James Taylor, of Birkenhead, and built and engined by Messrs. Simmons & Co., of Renfrew.

Liverpool Notes.

THE Guion steamer Avizona arrived in the Mersey on Saturday evening, the 26th of Decemher. and was shortly afterwards docked in the Alfred Dock, at Birkenhead. Her damaged bow, crushed through her colliding with an iceberg off the coast of Newfoundland, has been temporarily repaired with timber to bring her home; the job is most creditably done, the woodwork being neatly painted to correspond with the iron. The patch is scarcely discernable to an ordinary observer, and all praise due to the Newfoundland shipwrights is freely granted by their fellow craftsmen here who have inspected it. As if misfortune was following her, the Avizona was a few hours only in dock when she was discovered to be on fire: however, it turned out to be not of a very serious nature. As an officer and engineer were sleeping on board, the ships' fire engine was immediately set to work, and water poured down the ventilator. The fire had broken out among some bales of cotton stowed in a small compartment between two iron bulkheads on the starboard side of the steamer, The flames were confined to these bales, the iron bulkheads entirely preventing the fire from spreading, For a time, the firemen were unable to get at the seat of the burning. The bulkheads became red-hot, and the smoke from the burning cotton was suffocating, At last a man was lowered from the quay by the engineers, and the porthole of the compartment forced open, by this means hose pipes were introduced, and the fire got under, after burning for several hours. The origin of the fire was supposed to be spontaneous combustion of the cotton in the starboard bunkers. The Avizona after discharging her cargo proceeded to Glasgow to undergo an overhaul at the yard of Messrs. Elder & Co., her builders.

The Inman steamer City of Berlin, which sailed from the Mersey in the early part of December, was fitted with the electric light throughout the whole of the passenger deck, both saloon and steerage. Experiments were made on board the vessel as she lay in the river, on the evening prior to sailing, with a view of testing the adaptability of the light for ships' purposes. The results were thought to be so satisfactory that the electric light will by used on the passage to New York, and, if after this extended trial, it is found to answer, it will be adopted in all the vessels of Messrs. Inman & Co.'s fleet.

It remains to be seen on her return voyage what the results have been. The suggestion has has no doubt been instigated by the intense interest shown at New York on the matter after the collision of the Avizona. But, however well it may serve for a mast-head light, where no doubt it will be of great service in penetrating dense fogs and in enabling a lookout to be kept to a greater distance a-head, it will, we think, not be of much utility for other purposes on board ships, as when the crew or passengers upon turning from the intense light into the darker nooks and passages, so common to a ship, will be very liable to lead to confusion and probable accident. There has been cases known when the glare of an electric light upon being turned upon the men in the rigging of a ship, they become so dazzled with the light that they dare not move, in case of making a false step.

THE Railway Tunnel under the Mersey has, after several years delay, been actually commenced; land has been enclosed, and sinking commenced on each side of the river, and it is now evident that the work is to be pushed forward in earnest. James Brunless and Charles Douglas Fox, of London, are the Engineers, and S. C. Ridley, the Contractor for the work. The first contract relates to the distance from Grange-lane, Birkenhead, connecting the London and North Western and Great Western Systems, and the Dock Railways on the Cheshire side, and carrying a double line of railway under the river Mersey to Liverpool. The construction of sidings, passenger stations, and depôts for goods is included in the contract; and the works are to be finished in two years and a half. The importance of a tunnel connecting Birkenhead and Liverpool can scarcely be exaggerated. The great railway systems of Lancashire and Cheshire, now broken by the river Mersey will be connected, and the vast travelling public to and from those countries will be spared the loss of time and inconvenience through the tedious and sluggish necessity of crossing by ferry, which may be said to be anti-podal to quick locomotion, especially in foggy weather, which there has been so much of late, and which may have been disagreeably the cause of hastening the conclusion of the scheme. The benefits to Birkenhead will be enormous, as a freer exit for cargo will take more shipping to the half desolate docks of the Great Float. Vested interests on the Liverpool side have long prevented the Dock Board from assisting the tunnel scheme, which hitherto has been held in antipathy by that body. The shafts for the drainage headings will be sunk to a depth of 200 feet, from these points the tunnel will be cut through solid rock from one side to the other, so that there is no serious obstacle in the way of the engineering part of the scheme. This scheme must not be confounded with the Mersey Subway which is a distict and separate undertaking, intended for tramway cars, cabs, and wheeled vehicles, also foot-passengers. One-fourth of the total cost of £509,000 has already been guaranteed by the Birkenhead Corporation. Either, or both of these schemes completed will be a great boon to the public, the time now lost in crossing the river by business men, and those connected with shipping is simply incredible, and it seems strange that these sister sides of such a flourishing seaport, should have been so long without constant communication in this age of progress.

THE City of Richmond, of the Company, on her passage out from Liverpool to New York, encountered very heavy weather. When about 240 miles south-east of Halifax the wind increased in violence, and the waves rose to an unusual height, which caused the ship to plunge and the engines to race severely; during an extraordinary plunge, when the screw was lifted in the air, the shaft broke, leaving the vessel at the mercy of the elements with a headwind, and drifting away from land; the noise of the breaking of the shaft is described as a terrific report, alarming the passengers, until the cause could be explained and their fears partly dispelled. After drifting about helplessly for twenty-four hours, the Anchor Line Steamer Circassia came in sight, and ultimately took the City of Richmond in tow and made for the nearest Port, Halifax, where she will have to remain until a new shaft can be sent out to her. The owners of the Circassia have made a salvage claim of £10,420 for her services. It is stated that the City of Richmond had £625,200 in specie on board.

LASCAR CREWS.—The British India Steam Navigation Company's ship El Dorado, which put back through stress of weather, proves the futility of employing a crew composed entirely of natives. She was manned by sixty Lascars, with four English quarter-masters and English officers, and her passengers numbered about ninety. When the storm was at its highest, as the ship lay in the Bay of Biscay, the Lascars became incapacitated through exhaustion and fear, abandoning their posts in despair to the Europeans. The vessel shipped a sea which flooded the engine-room, and put out the fires, and it was simply owing to the exertions of the passengers that the El Dorado was saved and brought into port. The incompetency and collapse of native crews in the hour of peril, is nothing new to officers in charge of vessels trading in the East. Where the fatalistic ideas of the Mohamedan and his superstitious belief in the inevitable render him peculiarly unreliable, and serious mishaps are often only avoided through the force of example and powers of persuasion of the Europeans present. When all goes well, the Lascar is a willing and ready servant, but in the time of accident or emergency he is not to be relied upon. In fact, he is only a fair-weather sailor. In the case of the El Dorado, the necessity is more forcibly brought nearer home that in the interests of the passengers and shippers generally, a sprinkling of the crew at *least* ought to be sailors of our own nationality. Several of the large companies, such as the P. & O. Co. and Anchor Lines of late have had their home vessels almost if not entirely manned with Lascars who might at any day play the same trick with the vessels in which they are shipped as those of the El Dorado.

THE GREAT SUBMARINE BOAT.—Experiments were tried recently in the Great Float, at Birkenhead, with a most remarkable craft, evidently re-moddled from the Nautilis of Captain Nemo, in Jules Vern's work of "Ten thousand leagues under the Sea." The Resurgam, as the vessel is named, is 40 feet long and 9 feet beam, with a displacement of about 30 tons. She is of the cigar-shape, pointed at both ends, with a small raised coaming or casing amidships, which is decked over. Upwards from this stands a short funnel or conning tower, having bull's eye lights at either side and in front. The boat is steered and navigated from inside of this superstructure. The funnel through which the crew have to pass to obtain ingress and egress, is surmounted with a screw ventilation cap lowered and adjusted from the inside, a brass plate on the cap informs the curious that the vessel is Garret's Patent Submarine Boat. This is all that can be seen of her from the external world, when she is lying on the surface of the water. The motive power and the machinery being a mystery, as it has not been deemed prudent to divulge it. At present, however, the motive power to drive the propeller is generally from chemicals, also the oxygen necessary to sustain life. The crew, consisting of three, the captain, engineer, and owner wear helmets, into which the oxygen is pumped. It is said that when these helmets are removed for a time, a heavy drousiness overcomes the inmates, but upon again being donned, the spirits revive, and the wearer becoms energetic and alive to the situation. The screw is an ordinary propeller attached to one of the tapered ends. The vessel is sunk to the required depth by pumping the water ballast, and is assisted in ascending and descending by moveable fins at her sides. This novel craft descended to the bottom of the Great Float, and remained under water for three-quarters of an hour. When she returned to the surface, and had successfully accomplished the feat, the crew imerged one by one with red and smoked faces, looking as if they were glad it was over. Still they have been sanguine to venture to sea on a more difficult and somewhat doubtful trip round to Portsmouth, where she is to have her capabilities demonstrated to the Lords of the Admirality with a view to her *use* in torpedo warfare. The following is an account of the first stage of the trip by the inventor himself, the Rev. George William Garret, of Manchester:—Our crew consisted of myself, Captain Jackson (master marine), and Mr. George Price as engineer, and we left the Alfred Dock, Birkenhead, on Wednesday night, the 10th of December, about nine o'clock. The night was very dark and a little misty, which made it necessary for us to proceed cautiously down the river until clear of the shipping. However, we reached the Rock Lighthouse without accident of any sort, and entered the Rock Channel about ten o'clock. When we started, Captain Jackson remained outside on the look-out, whilst I took the helm in the conning tower; but as soon as we were fairly in the Rock Channel, Captain Jackson came inside, when we shut ourselves up and fairly started on our way. We passed down the Rock Channel, and, safely making Spencer's Spit, we turned into the Horse Channel, which we cleared in due course, and were then fairly at sea. We laid our course for the North-west Lightship, and went very slow, intending to make some experiments in Victoria deep as soon as daylight should come. When the morning of Thursday came there was a thick fog, which prevented our making the experiments we wished, and necessitated our proceeding very carefully. The fog did not lift all day so we mooved about testing various parts of our internal machinery till the next morning (Friday). The sun rose beautifully on that morning, and the weather being clear we were able to make some progress with our experiments. We had now been at sea about 36 hours, a great part of which time we were under water, and we felt desirous of making some port, as sleeping on board the Resurgam is not attended with such comfort as we might desire. At this time we found the North-west Lightship close at hand, bearing about north; so we determined to put into the river Voryd, as there is good anchorage there, and she will dry every tide, which is very convenient, as we are going to make a series of experiments with various propellers. The boat answered splendidly in the sea way. The seas pass easily over her, and cause hardly any motion, nor do they interfere in any important degree with her way or steering. The three of us landed at Rhyl in perfect health, but rather tired and dirty. However, after a good wash and hot dinner our comfort was entirely restored, and we could congratulate ourselves in having passed successfully through as novel and interesting a trip as any sailors could wish to experience. We remain at Rhyl for a few days, to perfect a few little matters of some importance to our future comfort.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES (ENGLISH).

Rhiwabon.—On Nov. 24 there was launched from Palmer's shipyard, *Jarrow*, a screw-steamer, named the *Rhiwabon*, sister ship to the *Rhyl*, the owners being Messrs. John Cory & Sons, Cardiff. The vessel, which is for the general trades, is 240 feet long, 33 feet broad, and 18½ feet depth of hold. She will be fitted up with Palmer's engines of 130-horse power. The ceremony of naming the ship was performed by Miss Armstrong, daughter of Mr. Robert Armstrong, shipyard manager.

Carolina.—On Dec. 11, Messrs. Edward Withy & Co. launched from Middleton Shipyard, West Hartlepool, an iron screw steamer, built to the order of Messrs Scott Brothers, of Newcastle-on-Tyne, on behalf of friends in Spain. This vessel is intended for the Spanish coasting trade, and will at the same time be occasionally used as a yacht by the owner, being fitted up with ladies' and gentlemen's cabins for the purpose. Her principal dimensions are:—Length between perpendiculars, 135 feet; beam (extreme), 20 feet; depth of hold, 9 feet 6 inches and 12 feet 6 inches. She will be fitted with compound engines of 50-horse power by Messrs. T. Richardson & Sons, of Hartlepool Iron Works, will class 100 A 1 at Lloyd's, has water ballast in fore hold and under cabin aft, accommodation for captain, officers, and engineers, in amidship bridge-house, two steam winches, and patent windlass; will be schooner-rigged, and is expected to carry a deadweight of about 300 tons. As she left the ways she was christened *Carolina* by Miss Florence Scott, of Tynemouth.

Villarino.—On Dec. 11, Messrs. Laird Brothers floated from one of their building docks at Birkenhead a new iron screw-steamer of 780 tons, and 163 nominal horse power, which has been built to the order of the Argentine Government, to be employed in their troop and store service. The vessel was christened the *Villarino* by Miss Elsie Laird, daughter of Mr. William Laird, and immediately afterwards was towed to the fitting-out dock of the Birkenhead Iron Works, and under the crane to receive her machinery, which has been manufactured on the premises.

Morven.—On Dec. 13, Messrs. Edward & Co. launched from Middleton Ship-yard, West Hartlepool, an iron screw-steamer, built to the order of Messrs. Jas. Gardner & Co., of Glasgow. This vessel is intended for the Baltic and Mediterranean trades, and for a light draught of water, combined with large measurement capacity. Her principal dimensions are:—Length, b. p., 242 feet; beam, extreme, 32 feet 6 inches; depth of hold, 16 feet 9 inches; and she will carry upwards of 1,600 tons on 16 feet mean draught. She has been built under Lloyd's special survey for the 100 A 1 class, and has long full poop and topgallant forecastle, water ballast under both holds, three steam winches, and direct steam windlass. She will be schooner-rigged, and will be fitted with engines of 130-horse power, by Messrs. T. Richardson & Sons, of Hartlepool. As she left the ways she was christened *Morven*, by Miss Bertha Withy, daughter of the builder.

Skylight.—On Dec. 13, a screw-steamer was launched at Bowling, from Messrs. Scott & M'Gill's yard. She has been built to the order of Messrs. Ross & Marshall, and is 100 tons burthen. The new vessel has been fitted with engines of 20-horse power, 12-inch cylinder and 15-inch stroke, by Messrs. Matthew Paul & Co., Dumbarton. The steamer was named *Skylight* by Miss Auld, daughter of Mr. William Auld, Bowling.

Resolute.—On the 13th Dec. there was launched from the yard of Mr. J. T. Eltringham, South Shields, an iron paddle steamer. Length, 100 feet by 18 feet by 9 feet 8 inches. She will be fitted with one side lever condensing engine of 68-h.p., having tubular boilers and feathering floats, and all most recent improvements. This vessel has been built to the order of Messrs. Rennoldson, the makers of the engines, and is owned by the Waterford Steam Shipping Co. (Limited), by whom she will be employed in the towing and passenger service. On leaving the ways she was named the Resolute by Mrs. J. M. Rennoldson.

Jane.—On the 13th Dec. Messrs. T. Turnbull and Son, shipbuilders, Whitehall, Whitby, launched a screw steamer, which was christened Jane. She is a vessel of 1,900 tons deadweight carrying capacity; her length between perpendiculars, 240 feet; breadth, 34 feet; and depth 17 feet 9 inches. The vessel is double-bottomed throughout both holds with water ballast, divided into tanks. She is provided with iron decks throughout, with patent windlass and steam winches. Her engines are by Messrs. Richardson and Sons, Hartlepool, and are of 130 horse power nominal.

Devonia.—On the 13th Dec. a screw steamer was launched from Palmer's ship-yard, Jarrow, and was named the Devonia by Mrs. Fryer, wife of Captain Fryer, the owner's superintendent. The Devonia has been built to the order of Messrs. J. and R. Borey, London, and is of the following dimensions:—Length, 242 feet; breadth, 33 feet; depth of hold, 20 feet 2 inches; engines 130 horse power, and is the highest class at Lloyd's. She is intended for the general trade.

Edmonton.—On the 13th of Dec. there was launched from the shipbuilding yard of Messrs. C. S. Swan and Co., Wallsend, a screw steamer of the following dimensions:—Length between perpendiculars, 255 feet; breadth, 34 feet; depth of hold 23 feet. The steamer is of 2,400 tons burthen, has been built under special survey to class 100 A 1 at Lloyd's, and is in excess of their requirements, having an iron main and upper deck, the latter covered with a wooden deck. The vessel is fitted with water ballast, has a full poop and top-gallant forecastle, with a long bridge amidships to protect the engine-room in rough weather. She will be fitted with a pair of compound surface-condensing engines, of 160 horse power, by the Wallsend Slipway and Engineering Company (Limited). This steamer has been built to the order of Messrs. Watts, Ward & Co., of London and Newcastle, and on leaving the ways was named the Edmonton by Mrs. Ward, of London.

On Dec. 15, there was launched from the Wear Shipbuilding-yard, Sunderland, by Messrs. S. P. Austin and Hunter, an iron screw-steamer of the following dimensions:—Length between perpendiculars 225 feet, breadth extreme 32 feet, depth of hold 16 feet 3 inches. She is constructed with long half poop bridge house, and top-gallant forecastle, to class 100 A 1 at Lloyd's. Her engines, compound surface condensing, and boilers, will be fitted by Mr. George Clark, Southwick. She is fitted with a patent windlass, three steam winches, donkey boiler, double bottom for water ballast, and all the latest improvements, and has been built to the order of a Leith firm for general trade.

Her Majesty's ship Kingfisher, 6, composite screw sloop, 1,124 tons, 900 horse power, was launched from the building slip at Sheerness dockyard at half-past 1 o'clock, on Dec. 17th. The building of this ship was commenced in August, 1878. The following are her dimensions:—Length between perpendiculars, 170ft.; extreme breadth, 36ft.; depth in hold, 16ft. 9in. She is to carry six guns—viz., two 7in. (90cwt.), two 64lb. revolving, and two 64lb. broadside guns. Her engines and machinery are being constructed by Messrs. Maudslay, Sons, and Field; the engines to work up to 70lb. The dockyard was thrown open to the public at 12 o'clock, and hundreds availed themselves of the opportunity to be present to witness the launch. Among those present were Vice-Admiral Sir R. J. Macdonald, K.C.S.I., Commander-in-Chief at the Nore; Capt. T. M. Jones, Superintendent of Sheerness Dockyard; Capt. T. B. M. Sullivan, Her Majesty's ship Duncan, and Royal Naval Barracks, Sheerness; Col. Still, R.A., &c. The shed in which the ship was built was decorated with flags, and a stand was erected close to the head of the ship for the band of the 13th Kent Artillery Volunteers. The Rev. Dr. Pain, chaplain of Sheerness Dockyard, conducted the short service appointed to be read on such occasions. The ceremony of christening was performed by Lady Macdonald, wife of Vice-Admiral Macdonald.

LAUNCHES (SCOTCH.)

Abeille. — On the 24th Nov. Messrs. Cunliffe and Dunlop launched from their shipbuilding and engineering works, Port Glasgow, an iron twin screw tug steamer of the following dimensions: 120 feet long by 19 feet beam, and 11 feet deep, built to the order of Messrs. Wolter and Co., Havre. Immediately after the launch the vessel was moored in the Builders' dock, where she will have her machiney put on board, which consists of two pairs of compound surface-condensing engines, each of 40-h.p. nominal, and boilers to correspond. On leaving the ways the steamer was named Abeille by Mrs. Dunlop, Glasgow.

Barcelona.—On the 29th Nov. Messrs. Alex. Stephen and Sons launched, at Linthouse, an iron screw-steamer of the dimensions 265 feet by 33 feet by 20 feet, and gross about 1,400 tons, built under special survey to the highest class in Lloyd's and in Bureau Veritas, and fitted, before launching, with compound surface-condensing engines of 159-h.p. nominal. The steamer which is a sister ship to the Malaga, launched at Linthouse last month, was named the Barcelona by Miss Elsie Stephen, 15, Park-circus, Glasgow. The Barcelona is intended for the fine fleet of Messrs. Robert M. Sloman aud Co., of Hamburg, and is the tenth vessel built by Messrs. Stephen for that firm.

Jose Perez.—On the 29th of Nov. the first launch from the Lower Woodyard, Dumbarton, since it has been occupied by Mr. Robert Chambers, jun., shipbuilder, took place, when a screw-steamer, built of iron, and of about 900 tons dead weight, was placed in the water. Her dimensions are: Length, 180 feet by 24 feet by 14 feet. She is to be fitted with engines of 310 horse power, to be supplied by Messrs. W. Paul and Company, Dumbarton. The vessel, which was named the Jose Perez by Miss Agnes Chambers, sister of the builder, is to the order of M. Niciso Perez, of Tyrol, Spain.

Conqueror.—On the 29th Nov. Messrs. Napier, Shanks, and Bell launched from their shipbuilding yard at Yoker a twin-screw steam tug, built to the order of the Clyde Shipping Company, as an addition to their towing fleet. She is fitted with all the most approved appliances for towing purposes and also for attending the recovering of wrecks, &c. The tug measures 122 feet long by 21 feet broad, and is fitted with vertical, two-cylindered disconnecting, compound, twin-screw engines of 150 horse power (Rankine's patent), constructed by Messrs. Rankine and Blackmore, of Greenock. On leaving the ways the vessel was named the Conqueror by Miss Blair,

Laertes.—On Dec. 2. Messrs. Scott and Co. launched from their shipbuilding yard at Cartsdyke, Greenock, a steamer of 2,146 tons. Her dimensions are as follow: length 320 feet, breadth 34 feet, and depth of hole 26 feet. She has been built to the order of Messrs. Alfred Holt and Co., of the Ocean Steamship Company, and is intended for the China trade. As she left the ways she was named the Laertes. After the launch she was towed into the Victoria Harbour, where she will have her machinery put on board. Her engines are to be 300 horse power.

Dubrovnick.—On the 9th Dec. there was launched from the dockyard, Dumbarton, belonging to Messrs. A. M. M'Millan & Son, a little screw steamer named the Dubrovnick, and belonging to the Ragusa Steamship Co., of Ragusa, Austria. The vessel's tonnage is about 300, and she is to be supplied with engines of about 60 horse power, which will be constructed by Messrs. Hutson and Corbett, engineers, Glasgow. The Dubrovnick is intended for the passenger and goods traffic between Ragusa and Trieste, and has accommodation for about 20 first-class passengers in her poop. She is fitted with water ballast, steam winches, and all the latest improvements.

Tisza.—On Dec. 13 Messrs. Blackwood & Gordon launched from their shipbuilding yard, Port Glasgow, a screw steamer of the following dimensions:—Length, 250 feet; breadth ot beam, 32 feet 6 inches; depth of hold, 17 feet 6 inches; 1,250 tons old measurement, and about 1,203 tons register. The vessel is classed 100 A 1 at Lloyd's. The engines, which are compound, and have been supplied by the builders, are of 125 nominal horse-power, and the cylinders are 30 inches and 52 inches in diameter, with a 30-inch stroke. This steamer, which has been named the *Tisza*, has been built to the order of Messrs. Burrell & Sons, Glasgow, is to be engaged in the Mediterranean trade, and will be commanded by Captain Lee.

Storebett.—On Dec. 13 there was launched from the yard of Messrs. Lobnitz, Coulborn & Co., Renfrew, an iron screw steamer of the following dimensions:—Length, 190 feet; breadth, 127 feet; depth, 21 feet. She she built to the order of the Llands Engelshe Damskibs-selskab, of Nakskov, Denmark, and is classed in Veritas highest class. She is fitted up with all the latest improvements for the cattle trade, and, being supplied with the builders' compound engines of 160 N.H.P., is expected to attain a high speed. On leaving the ways she was named *Storebett* by Miss Alwilda Lobnitz.

Athernie Castle.—On Dec. 15 there was launched at Dundee, by Messrs. Alex. Stephen & Sons, an iron barque, named the *Athernie Castle.* Her dimensions are:—Length, 224 feet; breadth, 36 feet; depth of hold, 21½ feet; and gross tonnage, 1,250 tons. She has been fitted with steam winch, condenser, patent windlass, and other appliances for the rapid discharge and embarkation of cargo. The vessel has been purchased by Liverpool owners, and is expected to be ready for sea in about six weeks.

Africa.—On Dec. 15, Messrs. Alex. Stephen & Sons launched from their yard at Linthouse, Govan, an iron screw steamer of the dimensions 260 by 33½ by 22, and about 1,553 tons. She has been built under special survey to the highest class both in Lloyd's and in Bureau Veritas, and fitted (before launching), with compound surface condensing engines of 165-horse power nominal. This vessel is for Edward Carr, Esq., Hamburg, and was named the *Africa*, by Mrs. Lass, of Hamburg.

Ardandhu.—On Dec. 15 there was launched from the shipbuilding yard of Messrs. H. Murray & Co., Port Glasgow, an iron screw-steamer of the following dimensions:—235 by 31 by 17, about 903 tons register. She was named the *Ardandhu*, and has been built to the order of Messrs. M'Laren, Crum & Co., of Glasgow, and is intended for the Spanish ore trade. She will be furnished by Messrs. Wm. King & Co., of Glasgow, with engines of about 98 nominal horse power.

Alpha.—On the 15th December a screw steamer of 500 tons built and engined by W. Simons and Co., was launched complete from their works at Renfew. Its dimensions are 140 by 23 by 11½ feet, and it is fitted up with compound engines of 60 nominal horse-power. This vessel is named Alpha, and is the property of the Corporation of Liverpool. It is intended for the rapid and economical removal of sewage and refuse from the town of Liverpool away into deep sea water, and is believed to be the pioneer of a fleet of similar steamers for that purpose.

Amsterdam.—On the 17th December Messrs. A. M'Millan and Son launched from their dockyard at Dumbarton the screw steamer Amsterdam, of 6,000 tons displacement, and 2,500 indicated horse-power. The Amsterdam has been built to the order of the Netherlands-American Steam Navigation Company of Rotterdam, snd is to be employed in the mail, passenger, and cargo service of this company between Rotterdam and New York. She has passenger accommodation on the main deck for 60 first-class and about 500 third-class, and is furnished with all improvements for safety, comfort, and economy of work. The Amsterdam is classed in the highest grades of Lloyd's and the Bureau Veritas, and is the eighth vessel launched this year by Messrs. M'Millan and Son, representing an aggregate displacement of 29,400 tons, and a gross register tonnage of nearly 14,008 tons.

LAUNCHES (Irish.)

Irish Minstrel.—On the 13th December there was launched from the shipbuilding yard of Mr. John Connick, Dundalk, a three-masted schooner called the Irish Minstrel, built under special survey, to class 11 years A 1 at Lloyd's; dimensions 100 by 25 by 11½. She is to be commanded by Captain Ferguson.

TRIAL TRIPS.

The Buenos Ayrean.—The steel screw steamer Buenos Ayrean, the latest addition to the Allan fleet, went down the Firth of Clyde on the 25th November for a short trip. The vessel left the Tail of the Bank about noon, and proceeded down the Firth as far as the Cumbraes, and behaved most satisfactorily, the engines working at full speed without the slightest hitch. After a very pleasant run the Buenos Ayrean returned to her anchorage opposite Helensburgh. On the previous day the vessel was tried progressively, giving a highest mean speed of 13·63 knots, the amount of deadweight on board at the time being 1,900 tons.

Cleveland.—On the 29th Nov. the Cleveland (s), built by Messrs. Craggs and Sons to the order of Messrs. Jerveland and Clepham, of Middlesbrough, and intended for the Danish trade, had her official trial trip. The inclemency of the weather prevented a long run. Her going powers, however, were fully tested, nearly 13 knots being made. The Cleveland loads with pig iron and coal at once for Copenhagen, and bring back a general cargo. Arrangements will shortly be made for the transfer of Danish cattle.

The Te-Anau.—On the 15th Dec. the screw steamer Te-Anau, built by Messrs. Wm. Denny Brothers, and engined by Messrs. Denny and Co., Dumbarton, went down the river on a trial trip. This vessel, which is the latest addition to the Union Steamship Company of New Zealand, is 270 feet long, 34 feet broad, and 25 feet deep, having a gross tonnage of 1,630. She has inverted surface-condensing engines of about 270 nominal horse-power, and is fitted with all the latest improvements. She has accommodation for 130 first-class passengers and 85 second-class, also a patent double bottom throughout for ballast purposes. The vessel ran the measured mile most satisfactorily with a dead weight of 1,100 tons on board. She attained a speed of 13 knots an hour. A series of progressive trials were also made, the results being carefully noted for future use. The engines worked most smoothly, and the ship better than almost could have been expected.

Kinfauns Castle.—On the 19th December Messrs. Donald Currie and Co.'s new mail steamer Kinfauns Castle, of 3,500 tons register, made her trial trip on the Clyde, drawing 19 feet of water. The engines indicated 3,150 horse power, with a pressure of about 70lbs. The speed attained was 14¾ knots. The Kinfauns Castle left the Clyde at 3 p.m. for London in perfect order. The builders are Messrs. John Elder and Co., Fairfield, Glasgow.

The new armour-plated ship Northampton, 12, Capt. J. Fisher (bearing the flag of Vice-Admiral Sir Leopold M'Clintock, who has been appointed to relieve Vice-Admiral Inglefield in the command of the North American and West Indian stations), completed the measured-mile trials of her engines at Portsmouth on December 15th. This full-power trial was in continuation of those which were undertaken on the 14th ult., and which, after the runs at two-third and one-third power had been completed, were prematurely brought to an end in consequence of the giving out of the steering gear, which necessitated the easing down of the engines. The ship during the runs was in command of Capt. Wells, while the working of the machinery was superintended by Mr. Charles Icely, Chief Inspector of Machinery, and Mr. Durston, of the Factory Department. Mr. Gosling represented the contractors (Messrs. John Penn and Sons, Greenwich), and among those present on the occasion, in addition to Vice-Admiral M'Clintock and his Flag-Captain, were Admiral Ryder, Commander-in-Chief at Portsmouth; Vice-Admiral Sir Houston Stewart, Controller of the Navy; Rear-Admiral Foley, Admiral Superintendent; Rear-Admiral Lethbridge; Mr. J. Wright, Engineer-in-Chief at the Admiralty; Professor Sir William Thompson, Lieut. Count Oscar Cassino (Austrian Naval Attache), Mr. W. B. Robinson, Chief Constructor; Capts. Jeffries, Herbert and Hallowes; and Commanders Brown (Assistant to Director of Naval Ordnance), W. May (Superintendent of Compasses), and Custance. Since the last trial, in order to give additional clearance between the propellers and the run of the ship, the diameter of the blades has been reduced by six inches at the leading edge to one inch at the following edge, thus giving a mean reduction of 14 inches. The draft of the ship was as nearly as possible the same as before—viz., 24ft. 9½in. forward and 25ft. 3in. aft. There was no wind, no sea, and, as a result very little draft in the furnaces, with a corresponding difficulty in keeping the cylinders (of which there are six) supplied with a full head of steam. A heavy bank of shifting fog lay along the northern shore, which rendered it occasionally difficult at times to discern the buoys and mile-posts. Owing, however, to the great experience of the senior pilot of the port, Mr. Harding, the runs were made without any stoppages taking place. The mean pressure in the boilers was 57·68lb.: the average vacuum in all the condensers exceeded 26in., that in the forward starboard condenser being 26·68in.; the mean pressure in the starboard cylinders was 26·549lb., and in the port cylinders 26·449lb.; and the indicated horse power of the starboard engine 3005·19, and of the port engine 3057·46 horses. The total power developed during the four official runs was thus 6062·65, which, being in excess of the contract power, was so far satisfactory. But the most extraordinary circumstance is that, while the horse power developed on Monday was about 500 more than before the modification of the screws, a mean speed of only 13·173 knots was realised, or substantially the same as before. There is, consequently, considerable waste of engine-power somewhere, though opinions differ as to the cause. It is quite true that the ship carried about five degrees of starboard helm, by means of which her way was retarded and the useful power of the engines handicapped, but at the former trial the ship carried as many as ten degrees of weather helm, so that the balance, so far as the performance of the ship is concerned, was still more noticeably in favour of the previous trial. The necessity of the starboard helm is attributed to the extra evolutions made by the port engine—the starboard engine making 83·63 revolutions, while the port engine made 85·41 per minute; but this remains to be proved by trials of the ship at various trims. It appears evident from the full-power trial that further modifications will be required in the propellers to secure better speed results, greater blade area being probably necessary to make up for reduction of diameter. The Northampton has received her new 12-ton guns on board, and shipped 800 tons of coal at Portsmouth.

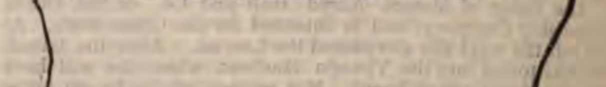
Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—Ed.]

PRIMING IN MARINE BOILERS.

To the Editor of the Marine Engineer.

Dear Sir,—I would claim the "Puzzled Engineer's" attention to the following expedient resorted to by my former employer, when his steam launch boiler primed; I have made a free-hand drawing to illustrate more clearly, what I would suggest; a piece of inch tubing, about eighteen inches long, pierced with as many holes as can be conveniently drilled, about an eighth of aninch dia-



meter with one end welded together, and a brazed flange on the other to fix it to the boiler with, was placed across the steam outlet inside the boiler; this cheap method was found to suffice, the reason I think is this: "Priming is caused by too small steam space being allowed for, the result being a rush of steam out of the outlet carrying the water along with it, after the injector principle, the tube, however, catches the water up, and prevents its entry into the cylinder.

I remain, yours truly, R. ALINGTON.

To the Editor of the MARINE ENGINEER.

DEAR SIR,—I am a Engineer, and a subscriber to your paper. I have been to sea once and I want to go again, could you kindly inform me the best way to go about it, and if there are any agents in London that could ship me, as third or fourth engineer, if you can you will extremely oblige your humble servant, A. W.

IMPROVEMENT FOR SAVING OF FUEL.

To the Editor of the MARINE ENGINEER.

SIR,—As I think it very probable that I may obtain valuable data and information from many of your practical subscribers, I will ask insertion of this letter in the next issue of your valuable journal.

In common with other Ship-owners, I am anxious to keep pace with the most modern improvements for the saving of fuel in my steam ships. I see that there are many divided opinions as to the relative economy in working of simple expansive, and of compound engines.

Can any of your practical sea-going Engineers give me disinterested information as to an economical improvement effected by compounding engines or the reverse. Or, are they cognisant of simple expansive engines running as economically as any compound ones can do? Any reliable information on these points will oblige. Yours truly, SHIP-OWNER.

Reviews.

Catechism of the Marine Steam Engine. By Emory Edwards. Published in England by E. and F. N. Spon.

This is a most useful and practical book, designed especially for working men seeking self-education to qualify as marine engineers, or for young students who desire capital practical advice and information about the marine engines of which they would wish to take competent charge. There is no doubt that there is a great need for such especially practical text-books. Amongst the better educated students there is at present an exaggerated leaning towards abstruse mathematics and pinciples and in consequeuce the value of practical handiness and tact in emergencies is being unduly under-rated. This text-book commences with plain straight forward definitions, and instances of the commonest used classes of engines and boilers. Examples, illustrations, and the best position and method of using boiler fittings then follows, with some most excellent chapters on the corrosion of boilers and the method of most easily effecting repairs at sea. These latter are the essentially practical chapters which form the peculiar characteristic and especial value of the text-book. There is a good chapter on "foaming" or "priming" with information as to the dangers of such a condition showing a false level of water in the boiler, and also sending over mixed water and steam into the cylinders and thereby endangering the covers. The work concludes with some interesting full-page illustrations and particulars of the most important improvements in modern marine engines which are the more interesting, as in some cases they are by American builders. Some useful tables of areas, square and cubic roots, temperatures, and volumes of steam and other mathematical data, close this valuable little treatise which we can heartily recommend to our readers whether seeking for practical instructions or for extended theoretical information.

Indicator Diagrams.—Published by Hughes, Fenchurch street.

We have before us a very useful note-book for noting and keeping indicator diagram. The book is interlined with tracing paper, on which to copy the diagrams and opposite each, diagram is a tabulated series of the principal points that are most usefully noted and remembered, such as, names of a steamer, nominal horse-power, vaccuum, steam pressure, consumption, speed of ship, &c. This is a most handy form of keeping and preserving diagrams which are easily lost as a rule, and thus not half the available information extracted from them.

Recent Applications for Patents connected with Marine Engineering, Ship Construction and Mechanical Appliances for use in Ships, from October 21st to November 20th, 1879.

Supplied by the City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

4748 J. G. Wilson (communicated by T. B. Scovell), Safety valves

4752. J. M. Stanley. Furnaces

4814. J. Dodge. Furnaces

4829. O. Oldham. Pistons and pump-buckets.

4845. G. T. Lyster. Facilating discharge of grain and bulk cargo.

4866. J. W. Spencer. Armour plates and projectiles.

4878. W. R. Lake (communicated by J. L. Lay.) Torpedo boats

4881. E. G. Brewer (communicated by J. L. Malarard). Rotary Engines

4888. E. T. Darke, Ascertaining power of engines

4894. M. L. Muller. Barometer

4908. J. J. Royle. Lubricating cylinders

4916. J, C. Newburn (communicated by J. Henas). Telegraph cable, &c., and insulated compositions

4921. J. Donaldson. Propelling high speed torpedo and other boats

4923. G. B. Brock. Steam boiler furnaces

4958. M. Marchichenski. Propelling boats

4967. J. & S. Clark. Pneumatic and electric signalling and communicating

4975. H. W. Pendred. Safety valves

4977. J. D. Churchill. Regulating supply of steam to steam engines

5006. J. Gillett. Steam engines

5006. J, Gillett. Unloading or transferring grain

5022. W. H. Cutler. Rotatory steam engines

5033. G. Quick. Beech-loading mechanism for heavy guns

5045. J. Muray (communicated by J. Peichl). Inclinatoriums or dipping azimuth compasses

5053. W. P. Thomas (communicated by M. Stewart). Mode of Shipment of oil, &c., and receptacles for same

5062. A. M. Clarke (communicated by S. Marmont). Smoke consuming furnaces

6078. W. R. Lake (communicated by T. Blake). Electrical signalling apparatus

5101. C. A. Tew. Automatic pulley block brake

5126. W. White, Electric signalling apparatus for use in loading and discharching vessels

5153. E. E. Mann. Signal buoys

5161. H. H. Lake (communicated by E. G. Parkhurst) Machine guns

5167. W. White. Steam boiler safety alarm

5175. A. W. L. Reddie (communicated by J. B. Siecardi). Insulating mariners' compasses

5184. Increasing speed and buoyancy of vessels.

Notes and Novelties.

THE Orient Steamship Company's new large steamer Orient, which we recently illustrated and described, has arrived at Adelaide, the passage from Plymouth, including all stoppages, having been made in thirty-seven days and twenty-two hours. The stay at St. Vincent occupied twenty-seven hours, that at the Cape, particulars of which are not yet known, in all probability would not have been less than twenty-four hours, the passage thus being made in rather under thirty-six days' steaming time. The fastest passages to Australia previously recorded are that of the Lusitania, from Plymouth to Melbourne direct, in about forty and a-half days, and that of the Cuzco, from Plymouth to Adelaide, in forty days eight hours. The distance from Plymouth to Adelaide by the Cape being about 12,000 nautical miles, the Orient must have maintained an average speed for the whole voyage of over fourteen knots per hour.

THE Hecla, torpedo ship, Capt. Morgan Singer, steamed out of Portsmouth Harbour, December 16th, for experimental practice with a Whitehead torpedo frame out at sea. This is the invention of Mr. Whitehead, the inventor of the fish torpedo, and was brought to England from Fiume by Capt. Singer, who has reported very favourably upon it after practising with it in the Mediterranean. Mr. Whitehead has supplied it extensively to the Russian and other navies, but the Hecla is the only ship to which it as been fitted in the English service, and only for experimental purposes. It is intended to overcome great disadvantage which attends the discharge of the locomotive torpedo abeam, or at right angles with the middle line when the ship is under weigh. At whatever height above the water-line the torpedo is fired, and no matter whether from a fixed impulse tube or from the ordinary carriage, it has been found that the projectile carries with it an impetus derived from the forward motion of the ship, and that it moves in a lateral direction after entering the water for sufficient a period to cause it to come into collision with the rudder or propeller. To obviate this danger Mr. Whitehead erects a frame outside the topsides of the ship, and which has a revolving action not unlike the paddle-wheel of a steamer. When ready for firing the torpedo is attached to the frame or blade by means of tongs, and the apparatus carrying the engine is made to revolve in an opposite direction to the way of the ship. When the neutral point is reached, which is 3-ft. below the water-line and perpendicular to the axis, the tongs open, and the torpedo speeds on its way in a straight line. The experiments were witnessed by Admiral Stewart, the Controller of the Navy, and by Admiral Foley, the Dockyard Superintendent.

THE Secretary of the United States Navy, in his annual report on the condition and operations of the Navy Department for the fiscal year ending June 30th, 1878, says:—"The condition of the Navy has greatly improved during the last year. There are now in commission thirty-five vessels, consisting of cruisers, monitors, and torpedo boats. Of the different classes, sixteen can be put in condition for sea service in a few months, and twenty could be made ready in an emergency. With this done, the fighting force of the Navy which might be made available in a very short time would consist of eighty-one vessels of all classes. And if to this number be added the four monitors, Terror, Puritan, Amphitrite, and Monadock, and eight powerful tugs, which can be fitted for either cruisers or torpedo boats, our whole effective fighting force would consist of thirty-three vessels. The monitors could be completed, with the necessary appropriations, without much delay. Of the vessels now used as receiving ships, seven are unfitted for any other service. There are twenty-seven vessels unfitted for naval purposes of any kind whatever, but which are a positive expense, as it is necessary to keep in employment a force of ship-keepers to preserve them from entire destruction. Some of them might be profitably converted into merchant vessels, and it would be economy to sell the whole."

THE LOSS OF THE "ROSCOMMON."—A correspondent writing from St. Michael's, Azores, on the 28th November, gives further particulars with reference to the capsizing of this vessel and the loss of six of the crew. He says:—"The Norwegian barque *Svanen*, of Grimstad, Captain Olsen, came off this port on the 26th inst., and landed Captain Stell and 15 men of the screw steamer *Roscommon*, 970 tons, which capsized at sea, 50 or 60 miles south of St. Mary's some days previously, through the shifting of the cargo whilst a heavy sea was running. Of those who were below at the time of the vessel heeling over three were never seen at all. Three others were washed away, or got jammed in their attempt to reach the boat, which the captain fortunately succeeded in getting launched, after a few minutes' unavailing effort to bring the vessel to and up. The captain reports that all hand behaved well, both before and after getting into the boat, but being without food or covering they were in a terrible plight, and of course anticipated much suffering. They had been 24 hours in the boat, the weather very wet and stormy all the time, when they were decried by the crew of the Norwegian barque, who took them on board and tended them with the greatest kindness. The barque, which was bound to Genoa, was not over-supplied with provisions for her own crew, and the men from the *Roscommon* still further shortened their supplies. On coming here steps were taken while she was lying off and on to recoup her stores, under the active superintendence of a London merchant, Mr. Tathum, of Pudding lane, who happened fortunately to be here at the time. The things were all passed through the Custom House and ready to be put on board when, night coming on and the weather looking very dirty, the barque made a board off the land, intending, as we presumed to come in again next morning. A severe gale of wind, however, sprang up from the north-east, and it blew fiercely the whole night. The weather has been very thick and blustering since, and we have been straining our eyes to make the barque out; but there is no appearance of her, or of the Lisbon mail boat, which is three days overdue. The following are the names:—John Evan, second engineer, Aberystwith; Thomas Ferguson, third engineer, Sunderland; Charles Cain, steward, Hamburg; John Robert, fireman, Liverpool; Claus Thalsen, A.B., Norwegian; Wellesley Bitton, engineer's steward, Sunderland."

FROM the recent torpedo experiments made on board the Bloodhound with the electric light it would appear that black painted boats are least distinguishable by the electric light, while white, red, and green, were the next in order of plainness.

THE Pacific Steam Navigation Company have decided to reduce their capital from £2,363,400 to 1,722,550 by reducing the amount of each share in the company from £40 paid up to £30 paid up, such reduction to be effected by paying off the sum of £10 per share.

BOARD OF TRADE EXAMINATION.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 c denotes Extra First Class; 1 c, First Class; 2 c, Second Class.

Henderson, Alx.	2 c	Greenck
Fernie, Peter	2 c	do.
Mollison, R.	2 c	do.
Hendry, Thos.	2 c	do.
Johnstone, Thos.	2 c	do.
Young, Jno.	2 c	do.
Fletcher, Archd.	2 c	do.
Pitt, James	2 c	do.
Fenton, Wm.	2 c	do.
Beck, James	1 c	do.
Brown, John	2 c	Lvrpool
Manley, L.	1 c	do.
Evans, Hugh	1 c	do.
Lundgren, C.L.W.	2 c	Hull
Hall, John	2 c	Abrdeen
Mitchell, Jas.	2 o	do.
Thompson, J.	2 c	Sndrlnd
Spour, Wm.	1 c	do.
Metcalf, S.	1 c	do.
Jones, Edward	1 c	do.
Blackett, J.	1 c	do.
Berrill, Peter	2 c	Lvrpool
Lindsay, Wm.	2 c	do.
Farrelly, Chas.	2 c	do.
M'Callum, Jno.	2 c	do.
Greig, Geo.	2 c	Leith
Fairweather, J. G.	2 c	do.
Dousling, Thos.	2 c	N Shlds
Shepherd, Hy.	2 c	do.
Herkess, Thos.	2 c	do.
Grant, Peter	2 c	do.
Sorensen, Aler.	2 c	do.
Hall, George W.	2 c	do.
Mackey, Wm.	2 c	do.
Turnbull, S.	2 c	do.
Fowler, Rbt.	2 c	Lvrpool
Gardiner, Wm.	2 c	do.
Rankine, D. A.	2 c	do.
Morison, Alex.	1 c	do.
Mitchell, Wm.	1 c	do.
Hubbard, Albert	2 c	London
Rees, Daniel H.	2 c	do.
Dutton, Albert E.	2 c	do.
Tyler, Harry T.	2 c	do.
Packham, Alxr.	2 c	do.
Roods, Chas. H.	2 c	London
Lawson, W. M.	2 c	N Shlds
Ericksen, Erik A.	2 c	do.
Schnack, S. F. A.	2 c	do.
Dysart, Thomas	1 c	do.
Dryden, Robert	1 c	do.
Scott, Joseph R.	1 c	do.
Young, Ebenezer G	1 c	do.
Metcalf, S.	1 c	do.
Kean, Geo. N.	1 c	do.
Smith, Chas. E.	2 c	London
Brand, David	2 c	do.
Angus, George	1 c	do.
M'Intyre, C. A. M.	1 c	do.
Aitken, Nichol	1 c	Lvrpool
Rees, Thos. B.	1 c	Bristol
Young, Jno.	2 c	Glsgow
Angus, Alex.	2 c	do.
M'Callum, Jno.	1 c	do.
Parlane, Jno.	1 c	do.
M'Farlane, A.	1 c	do.
Davison, Geo.	2 c	Sndrlnd
Sewell, Jno. W.	2 c	Hull
Ashton, Wilfred	2 c	do.
Newall, Chas.	2 c	London
Brodie, Ralph	2 c	N Shlds
Walworth, T. B.	2 c	do.
Weddell, T. M.	1 c	do.
Laird, Laurence	1 c	do.
Halcrow, James	1 c	do.
Brow, George	1 c	do.
Hankey, Charles	2 c	Lvrpool
Taylor, Wm.	1 c	do.
Kirkland, John	1 c	Leith
Goodeve, Wm.	1 c	do.
Weir, James	2 c	Grnock
Mackintosh, A. R.	2 c	do.
Thomson, J. W.	1 c	do.
Macgill, Robert	1 c	do.
Watson, John	2 c	Abrdeen
Henderson, John	2 c	do.
Roberts, William	2 c	Hull
Corringhan, Wm.	1 c	do.
M'Kenzie, Colin	2 c	Grnock

ROBERT JACKSON, Registrar-General.

General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

Robert Walker's Patent Hydro-carbon Furnace and Apparatus

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; one ton of Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c.
8.—Cleanliness.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

The Inventor's Record—Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S. (from the reports placed before us of the actual working of the invention) we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little pactical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with coal.

The Railway Record states "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers.

The Marine Engineer.—For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300, total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons, and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4.000 per voyage.

Iron.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The European Mail.—"Thus in one of our Transatlantic steamers, the space that could be economised when filled with freight, at the present rate, would give us £3,000 (15,000 dols.) over our present receipts. These advantages are immense and must eventually effect a complete revolution in our present mode of steam generation."

For all particulars respecting cost of the Patent Hydro-carbon Furnace and Apparatus and terms of Royalties, application should be made to the patentee, Mr. Robert Walker, C.E., 19 Buckingham-street, Strand, W.C.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any M.S.S.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 26th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to W. G. Neal, and Crossed Commercial Union Bank, Limited.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER, payable in advance, is Five Shillings per annum.

The Marine Engineer,

LONDON, FEBRUARY 2nd, 1880.

EDITORIAL NOTES.

The world has known a golden and an iron age, and now we bid fair to realise an age of steel. Already steel is rapidly displacing iron for rails, girders, wire, boilers, and vessels. Nearly every ship-building yard in Great Britain has at present in hand one or more vessels built entirely of steel. The substitution of steel for iron in ships, plates, angles, and frames, promises to be nearly as rapid as the substitution of iron for wood. So recently as 1850, out of a total tonnage of 133,695 tons of shipping built in the United Kingdom, only 12,800 tons were of iron, the rest being of wood. Ten years later 64,699 tons, out of a total of 211,968 tons built, were of iron, and ten years later still, or in 1870, 272,000 tons of iron shipping were built, as compared with about 100,000 tons of wooden vessels. In 1878, however, over 400,000 tons of new iron shipping were launched in the United Kingdom, whilst wood has almost disappeared altogether. There are no figures as yet from which to judge as to the extent to which steel has already displaced iron, but we should not be surprised to find that already at least a quarter of the total tonnage is built in steel. Steel has had a long and severe trial before it has received its present favour at the hands of shipowners and builders. Nor is there even yet much evidence as to its advantages in reliability and length of life. The first results were far from satisfactory, but this was probably owing to the character of the steel first employed, and far from homogeneous. As the present steel plates of most perfect homogenity are being produced both by the Bessemer and open hearth systems. This steel has wonderful ductility, combined with increased strength, so as to be in all ways more reliable than iron. The tensile strength of this steel is uniformly 30 per cent. greater than that of the iron usually employed. This is now so universally recognised that the Board of Trade allow a reduction of 20 per cent. in the thickness of the plates and scantlings. The stipulated ductility specified under breaking test is an elongation of 20 per cent. on a length of eight inches before fracture. Although the improved value of steel *per se* is thus entirely to be accepted, it is still a matter of supposition how long the steel may last against corrosion, to which it is more probably liable than iron. We hope the ship owners may not be disappointed in its use.

The Russian naval captains, it appears by a late court-martial, are quite equal to inventing a glorious victory out of a strategical movement to the rear. This may be a pleasing and harmless delusion, as long as it only serves to enliven the mess or a fire-side tale, but it becomes an embarassing fiction, when crowned heads have awarded crosses and rewards for the imaginary victory, and the said victory is afterwards flatly contradicted by the second officer. Captain Baranoff, naval aide-de-camp to the Czar, was in command of the corvette Vesta in the Black Sea during the late Russo-Turkish war. He reported a most sanguinary battle and glorious victory over the large Turkish war-vessel Fedji-bulend. For this gallant action he was awarded unprecedented honours from the Czar and the Russian people. The German Emperor sent him the Cross for Military Merit, and the Shah of Persia gave him the order of the Lion and the Sun. Russian society was, however, soon after startled by a series of articles published in the *Novoye Vremya* by the second officer, Lieutenant Roslidestvensky, in which he declared that there had been no fight at all, but that the Russian corvette had simply saved herself from capture by a hasty flight and greater speed. The Marine Department, after much contradiction betwen the two officers, has directed Captain Baranoff to be tried by court-martial, and the resulting sentence was that he is dismissed the Russian service. He has received no less than nine Russian and four foreign orders. We should think the Russian service is well quit of him, and any others like him.

One of the disastrous losses at sea which characterised that most unfortunate year 1879 was that of the British steamship Borussia, which was abandoned at sea on Dec. 2. A portion of the survivors only, eleven in number, were landed early in the past month at Baltimore, and have given a most vivid account of the abandonment of the steamer. The first intimation of disaster was the discovery of a leak on the morning of the 1st of December, which rapidly increased, and, as it was situated in the engine-room, threatened the extinction of the fires. Knowing their imminent danger from this cause, the whole of the crew were put to the pumps. The water, however, steadily gained ground, and soon flooded the engine-room, extinguishing the fires and stopping the engines. We have repeatedly called attention to the disgrace cast upon owners of steamers, especially of those required to carry passengers, by the neglect to supply such steamers with adequate steam pumping power, of a centrifugal or similar class, to properly grapple with any such cases of sudden leakage. We have pointed out that such pumping power might at all times be made use of as circulators to the condensers, and this disastrous loss of the Borussia is but another forcible instance to add additional weight to our admonition. The stopping of the engines left the Borussia entirely at the mercy of the waves, which swept her deck from stem to stern. At the same time she was rapidly filling beneath her living freight. One appalling incident occurred during the course of the night. The lady passengers had been induced to remain below, whilst the crew and male passengers were clinging in a half-drowned condition to the bulwarks. One, however, of the ladies, with a child in her arms, suddenly appeared at the head of the cabin stairway. Some seamen and passengers, about fifteen men in all, rushed to warn her of her danger from the heavy seas and to assist her, when a great volume of water bore down the length of the vessel from the bows, and the next moment the despairing shrieks of the whole sixteen were heard in the sea to leeward. In the course of the next day all the small boats that had not been destroyed were got ready, as the Borussia was in a sinking condition. The party in question were on the open sea for three days, and were at last picked up by the Italian barque Giacomino, where they were treated with every kindness, and at last landed safely at Baltimore.

The march of progress in the construction of the best class steam vessel or liners seems to be advancing with re-doubled energy. We have scarcely yet recovered from astonishment at the marvels of the Orient, her splendid equipment, her gigantic size and speed. We hear she has just completed her most successful passage to Australia in thirty-six days, making an average speed of fifteen knots an hour throughout her voyage. Her engines are also reported not to have felt the strain in the least, but to be in as good condition as when she started. Here is a triumph for naval architecture and engineering skill! A formidable rival has, however, just been put in hand, which, at any rate in size and speed, puts even the Orient in the shade. The Barrow Ship-building Company have just commenced the work, to the order of the Inman Company, of constructing what will be the largest steamship in the world, excepting the Great Eastern. The new steamer is to be called the "City of Rome," and will be 8,300 tons burthen, whilst her engines will be 8,500 nominal horse-power. She is expected to steam sixteen or seventeen knots an hour, and will be fitted with all the latest improvements for the comfort of the passengers, including the Siemen's electric light.

The warlike branch of the naval service is, however, keeping prompt pace with the rapid strides in the mercantile marine. The Duilio seems to be big enough and strong enough to put most of our vaunted ironclads' noses out of joint, both figuratively and practically. She has just been put in commission in the Italian Navy, and has cost the tidy sum of 22,000,000 francs. Her displacement is 11,500 tons, and her armament is four 100 ton guns, besides twelve smaller guns and four mitrailleuses. She is evidently a triumph of engineering skill, and we think her crew ought certainly to be all fitters, as all heavy work aboard, such as steering, regulating ventilators, removal of cinders, weighing anchor, is done by steam. There are thirty-three special engines. She is expected to attain a speed of twelve and a half knots, as her engines are 7,500 nominal horse-power, though we think this seems hardly to be obtained from such a low proportion of power to displacement. She carries a Thorneycroft torpedo boat, about 70 feet long, and which can travel at a speed of twenty-one knots; so, altogether, she is about as ugly a customer as it would be possible to meet.

We cannot refrain from giving a slight notice to the lamentable accident on the Tay, resulting from the collapse of the lofty railway bridge crossing the Tay. We are very much inclined to think that this accident has resulted from a want of attention on the part of the designers to the enormous overturning leverage offered by the exceptionable height of the bridge to a strong hurricane. The height of the centre of the effort of the wind to overturn above the piers may be considered as nearly five times the average breadth of base of the columns of the pier. This would have the effect of causing, whatever the total wind pressure might be on surface of the whole girder, to be increased five times as tension and compression on the windward and leeward set of columns forming the piers. The pressure of the wind, too, was probably higher than any former recorded wind pressure in England, and is said to have reached 52 or even 60 lbs. per square foot. We also think that a grave error has been, and is still, made in estimating the wind strains on such articulated structures, such as lattice girders or piers. Many of our readers could, no doubt, from their personal experience, give a much better idea as to resistance offered to the force of a hurricane by a vessel under perfectly bare masts. It has been the practice to estimate the resistance offered by any open structure, such as girders, by multiplying their actual solid area only into the pressure of the wind per unit of area. We cannot, however conceive that the heeling of a vessel in a hurricane, or her speed before the wind with bare poles, is estimated only by the pressure of the wind on the actual area, exposed to it. We think otherwise—viz., that obstacles in a current of air offer the same peculiar resistance that they would do in a fluid flowing past them. In this case the openings between the solid parts of the open structure would not allow the free passage of a volume of air, or fluid equal in area to that of the opening, but deduced to half that amount. If this is so, and practical experience of hurricanes at sea seem to point to this conclusion, the actual pressure on the superstructure of the Tay bridge was about four times greater than that ever thought of or allowed for by the engineers who constructed it.

It is probable before the final order is given to sacrifice the 38-ton gun brought from the turret of Her Majesty's ship Thunderer; by double-loading, that two or three more rounds will be fired under new conditions, in order to illustrate another aspect of the subject. The gallery, or splinter trap, erected in front of the embrasure to prevent fragments of the gun, provided it bursts, from scattering, is being greatly strengthened by the Royal Engineers, and will be finished by Wednesday next: but no date is yet named for the next experiments. In the last two rounds fired the pressures on the bore of the gun were quite normal, and the velocity of the projectiles was unaffected by the jammed wads inserted in the bore of the gun.

STEEL SHIPS.

There are few applications of steel that are likely to command more consideration in the immediate future than that of shipbuilding. Steel ships are not a new thing, they have been more or less before the world for upwards of twenty years. But it was not until a few years ago, that the use of steel for this purpose was attempted on a scale sufficiently large to give anything like an adequate idea of the advantages, or otherwise, secured by its adoption. The earliest applications of steel had no regard to the question of economy. Their main purpose was that of obtaining increased spead and a shallow draft, and this was got by the greater lightness of the material. For these purposes steel was employed as far back as 1852 in the construction of vessels designed to navigate the Rhine. Two or three years later a steel punt was built for the navigation of the Zambesi by Dr. Livingstone. Between 1857 and 1860 a large number of vessels were built of the same material with a view to navigating shallow waters in India, Russia, Germany, and England. During the American war, also, many vessels were built of steel to run the blockade. But in all these cases the difference of cost entailed by the substitution of steel for iron was enormous. Even in 1858, two years after the Bessemer process was first brought before the world, as much as £50 per ton was frequently paid for steel plates, which was more than treble the cost of iron. Nor were the early steel ships in all cases as successful as their builders anticipated. Dr. Livingstone pronounced the use of steel in his own case to be an utter failure, and took care to inform the world of the fact through the Society of Arts. In other cases, the application of steel was looked upon as more than doubtful, corrosion on the one hand, and high cost on the other, rendering it quite the reverse of economical. Now, however, steel manufacturers have placed at the disposal of shipbuilders a very different quality of material, and at a very different cost. In some recent contracts for vessels to be constructed of open-hearth steel, the material has been purchased as low as £10 10s. per ton, which is less than half the lowest price paid for steel plates only ten or twelve years ago. Manufacturers have, moreover, applied their energies to the production of a metal specially adapted to shipbuilding—a metal so mild as to bend rather than break in case of a severe strain, and yet possesing a higher tensile strength than wrought iron. With such a metal approximating iron in first cost, and with lighter scantlings sanctioned by both the Board of Trade and Lloyd's Register, steel would appear at first sight to have everything to recommend its adoption. It has still, however, to redeem not a few past failures. It has not, so far, proved its superior endurance. It is believed by many, to be more liable to corrosion and exfoliation than iron, and shippers are still accustomed to look with apprehension upon any reduction of the thickness of ship plates, lest it should cause a greater liability to "buckling" in the case of such a strain as that recently endured by the Arizona. On the other hand, however, the advantages offered by steel are so manifest that many important shipowning firms have given it an avowed preference. The Cunard, the Allan, the Pacific, and other leading lines are now using steel in the construction of vessels upon the safety and soundness of which, thousands of lives will be daily dependent. Such being the position of affairs, it becomes of great moment not only to the owners and builders of vessels, but to the general public, who must commit their lives and property to the new material, that the relative qualities of iron and steel and the probable results of the general use of the latter should be better understood.

Obviously, the first consideration that arises in dealing with the substitution of steel for iron, is that of its suitability. Within the last few years a great deal has been done in the way of determining this question. The answer may be said to be already at hand in the more extended application of steel not only for plates, but for angles and rivets as well. Mr. Barnaby and others have found that steel plates have cracked and fractured in a mysterious way; and it is still largely an open question whether this is due to the manufacturer, or to the carelessness of the workmen employed in the shipbuilding yard. Manufacturers, of course, allege that the fault lies with the latter, and this is confirmed by the experience of Lloyd's surveyors and other authorities. It would seem thus to be established, that in the treatment of steel plates a greater amount of care and skill is necessary than is called for in dealing with iron, and Mr. Barnaby has expressed the opinion that so long as this additional care is requisite, it would hinder the adoption of steel angles for the frames of ships. It is also still a moot point whether steel is more liable to corrosion than iron. Experience on this matter has been extremely conflicting; so much so, indeed, that scarcely any two authorities are exactly agreed as to how far liability to corrosion will affect the life of steel ships. Mallet's experiments, as reported to the British Association in 1842 and 1849, accorded to iron a greater power to resist corrosion than steel. The same conclusion has been arrived at by the Admiralty Boiler Committee, who find that, "under ordinary working "conditions, mild steel corrodes by pitting, and in a general "manner, much more rapidly than wrought iron, both in "fresh and in salt water." Others, however, have arrived at quite opposite results. At Terre-Noire, in France, experiments extending over about three years, are said to have established the fact that when exposed to the action of sea water, mild steel suffers from corrosion only in proportion of 60 to 140 when compared with iron plates. Many of the first vessels built of steel have confirmed this result more or less emphatically. One vessel constructed in 1859 for the Pacific Steam Navigation Company, was examined in 1874 and found to be in an excellent state of preservation, and experiments made on the Camel at Portsmouth have proved that while the steel is more corroded and pitted at points of the surface, the iron is uniformly rougher. It is probable that the singularly conflicting results obtained have been due to differences in the conditions of treatment—such as the temperature the chemical composition of the metal, the extent of the corroding agent having access to the plates, and the length of time over which such exposure takes place. But after due allowance has been made for the doubt and difficulty that still attach to such important questions as that of corrosion the advantages of steel become less equivocal Such an excess of ductility and tensile strength is secured by the use of that metal, that Lloyd's allow a reduction of 20 per cent. in the thickness of the plating and frames of steel vessels. Up to the present time, open-hearth steel appears to have been largely preferred to Bessemer for shipbuilding purposes, because the process is such that by continually sampling and analyzing the metal, uniformity can be absolutely depended upon. Bessemer steel, however, is much more generally employed than it was, and authorities—including Lloyd's surveyors—have affirmed that both descriptions of steel may now be absolutely depended upon. The tensile strength of steel plates is about 30 per cent. greater than that of iron; they are much less liable to be distressed by punching closely-spaced lines of rivet holes; and, as they are equally strong both crosswise and lengthwise instead of having their strength, like iron, in the direction of the fibre only, they are obviously more to be depended upon. In France the Government stipulate that steel for shipbuilding shall have a tensile strength of 30½ to 31½ tons each way, with 22 per cent. of ductility; Lloyd's stipulate that shipbuilding steel shall have an ultimate tensile strength of not less than 27 tons, with an elongation corresponding to 20 per cent. on a length of eight inches before fracture; whilst the Dutch Government stipulate for a tensile strength of 27 to 31 tons. Many authorities, however, consider these limits much too low, and leading manufacturers in this country have urged that the upper limit might be raised to 32 tons without any danger of obtaining brittle plates, so long as the temper and other tests are enforced. The absence of lamination, peculiar to steel plates, is another advantage over iron, the surface of the plates being so smooth that not half the labour is required in scraping, cleaning, and painting after they have been fixed in their places.

The economy to be obtained by the use of steel, is another matter of much concern to both shipowners and shipbuilders. In a steel vessel built on the Tyne about two years ago for the Bilbao trade, it was found that the extra cost involved by the substitution of steel was 7½ per cent. and against this there was an extra carrying capability of 84 tons. Since then, however, steel plates have fallen considerably in price. There would seem, indeed, to be no good reason why steel plates should not come as near the price of iron as steel rails have done to the cost of iron rails. As the demand increases so will the supply, and with a greater area of competition prices will certainly fall. Already, indeed, the demand for steel plates has reached in the United Kingdom an aggregate of over 80,000 tons a year, although their production has been limited to about half-a-dozen works. But so confidently do manufacturers anticipate an access of demand, that in Scotland, in the north of England, in Sheffield, and in

Wales, provision is now being made for extending the production In the Cleveland district the Consett Iron Company, heretofore, perhaps, the largest manufacturers of shipbuilding iron in the world, are adopting the open-hearth system of steel manufacture, and are likely to make as great a mark with the one material as they have with the other. It has been calculated by a high authority that the additional cargo-carrying capacity provided for in a steel vessel will exceed 25 per cent on the additional outlay entailed by the higher price of the material, or about 2 per cent. on the whole cost of the vessel. Experience has amply proved that steel is much more durable for railway and other purposes than iron. There are, however, no similar *data* available concerning the relative life of steel for shipbuilding. There are iron vessels now afloat that have been in service for over thirty years. No steel ship has been afloat for an equally long time. Even so, indeed, the means of a comparison would still be incomplete, seeing that the quality and suitability of the steel employed twenty years ago differed greatly from that of the steel now available. But it is fair to assume that the the life of steel ships considerably exceed that of iron; having regard to the ascertained superiority of steel for other purposes Nor does the advantages of the new material end here. The greater lightness of steel will enable voyages to be made with greater speed—so much so, indeed, that authorities whose opinion is entitled to weight confidently expect the Atlantic passage brought within seven days. All things considered, it is highly probable that steel will henceforth have almost entire possession of the field as a shipbuilding material, and, now that its claims are fairly recognized, will supersede iron as rapidly as that material has already taken the place of wood. In both directions the extent of the change accomplished is less known than it ought to be. So recently as 1850, out of a total tonnage of 133,695 tons of shipping built in the United Kingdom, only 12,800 were of iron. Ten years later, 64,699 tons, out of a total of 211,968 tons built were of iron; and ten years later still, about 272,000 tons were built of iron, as against less than 100,000 tons of wood. In 1878, however, over 400,000 tons of new iron shipping were launched in the United Kingdom, while wood has almost disappeared altogether. The tonnage of iron ships built in the United Kingdom since 1869 has been 93 per cent. greater than in the period 1860-68. There are no figures to enable us to judge of the extent to which steel has already displaced iron; but it is tolerably well-known that steel vessels are at this moment being built in almost every shipbuilding yard in the United Kingdom, that shipbuilders and shippers alike are evincing a preference for its use, and that its further application is only limited by the means available for producing the material. It is manifest that one effect of the more general use of steel must be that of limiting the quantity of material produced. To construct 400,000 gross tons of shipping will absorb over 300,000 tons of iron, but of steel 20 per cent. less would be required; and when to this diminished tonnage of material we add the presumably longer life of steel ships, the conclusion seems justified that shippers rather than manufacturers and shipbuilders will profit by the change.—*The Times.*

Liverpool Notes.

THE NEW FERRY APPROACHES AND LANDING STAGE AT SEACOMBE.—The new landing-stage, ferry-buildings, and approaches which have been constructed at Seacombe, with a view to accelerate the ferry traffic between that place and Liverpool, across the river Mersey, at a cost of nearly £150,000, were thrown open a few days ago for passenger traffic. Begun in 1876, and now nearly completed, the new ferry works have brought about considerable changes in that part of the district in which they have been undertaken; also offering greater facilities of communication with shipping about the Wallasey and Birkenhead Docks. The higher part of the banks of the river have been excavated, and the material thus obtained has been used to fill up a triangular piece of beach which existed between that point and the Alfred Dock entrance. A substantial river wall over 1,000 feet long has also been constructed, with a flight of granite steps for the accommodation of barges and boats. The total area of the reclaimed foreshore is 18,329 yards. The landing-stage is 315 feet long by 80 feet wide, and has an embayment for cargo traffic at the south end. It is floated upon 21 pontoons placed transversely to the length of the stage, and each pontoon is divided into water-tight compartments by bulkheads. The ferry station—a very handsome building—covers the north bridge pier and platform, extends inshore over the river Fall, and is lighted by skylights in the roof, in addition to windows at the side and ends. An office, a commodious ladies waiting-room, and ample conveniences are provided in the station. The floors of the waiting-room are formed of wooden blocks on the entrance or Seacombe side. The approach to the ferry from Victoria Road is about 400 feet long and 122 feet wide, and has white flagged footwalks, concrete forming the surface of the road. The whole lends a light and cheerful appearance, and comfort to passengers about to cross the river quite in contrast to the old state of things which they have had to put up with for many years. In addition to the improvements on shore two commodious and comfortable passenger ferry boats were lately added called the "Primrose" and "Daisy," also a goods boat named the "Gunflower," a great acquisition to the Seacombe Ferry. It was at this ferry twelve months ago that a serious collision happened betweeen the ferry steamer "Gem" and the ship "Bowfell" during a fog, in which many lives were lost. An accident also happened during the construction of the stage when a pontoon camel capsized with about 40 men upon her who were thrown into the water. They were all eventually saved with one or two exceptions.

THE ELECTRIC LIGHT AT SEA.—The Inman Steamer "City of Berlin," on board of which, on her recent voyage to New York, the electric light was fitted by way of experiment. The experiment is said to have been highly satisfactory. Not only was the saloon of the vessel brilliantly illuminated, but the steerage, usually the most gloomy part of the vessel, was lighted up in all parts. It is probable that the electric light will be used on all the vessels of the Inman fleet.

HEAVY WEATHER IN THE ATLANTIC.—The White Star steamer "Republic" while on her way to New York, from Liverpool, had funnel, lifeboat, stone ventilators, and hatches washed away, and other damage done by an immense sea which swept over the vessel. Several other vessels experienced fearful weather during the latter part of December and the beginning of January.

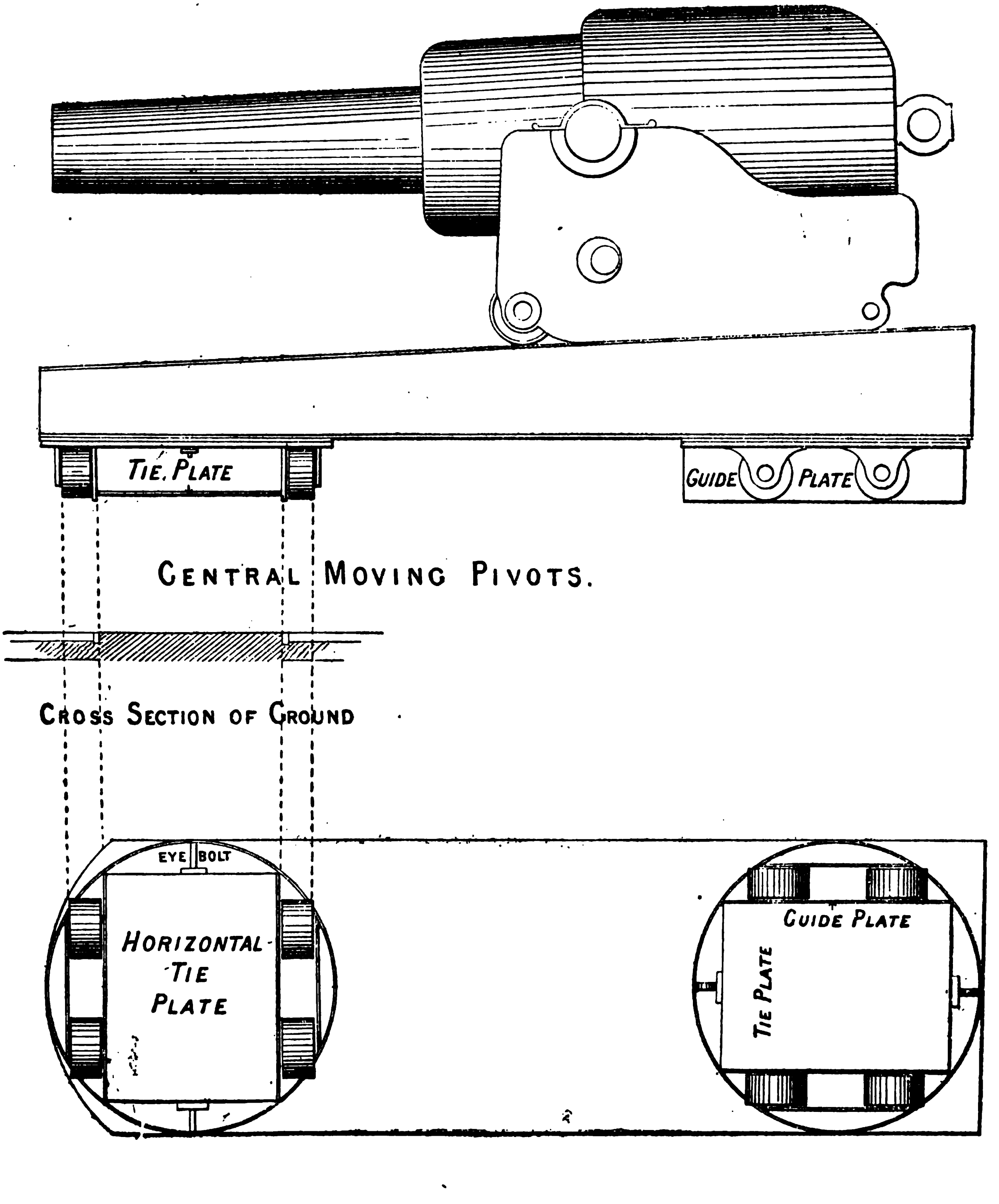
The Guion steamer "Arizona," after receiving a thorough overhaul at the hands of her builders.—The Messrs. Elder & Co., of Govan, arrived in Liverpool, from the Clyde and has since been replaced upon her station. Messrs. Elder in order to expedite the works, used the electric light at night to enable repairs to be finished quickly. A new iron stern had been fitted to her, to replace that knocked away in her encounter with an iceberg. It was found that 20 feet of ironwork at the bow had been carried away, but the hull was alright, and not a rivet slack, giving evidence of a strong substance job. Some further improvements have been made in the saloon, parquetry flooring having been substituted for carpets. The Arizona resumed her sailings on the 24th of January.

An accident happened on the 22nd ultimo to the Tranmere ferry steamer Harry-Clasper. The steamer had just started from the Liverpool landing-stage to cross the river, when one of the cylinder covers blew off—luckily no one was injured, the passengers being immediately transferred to another boat.

James Williams, an engineer, of one of the Tranmere ferry boats, accidentally fell off the end of the pier at Tranmere, to the beach below, a depth of 25 feet. The tide being out at the time he had to be hauled up to the pier by ropes, and was found to be fatally injured.

The Cunard Company are introducing a new run for their steamers in addition to the Atlantic and Mediteranean services which they have carried on so long and so successfully. The "Batavia" is to sail on the pioneer trip from Liverpool to Bombay direct, *via* the Suez canal, on Thursday, the 12th of February.

The Woodside Ferry Committee have decided to build another ferry boat to carry goods and luggage similar to the Oxton (which we illustrated in the January number of the *Marine Engineer*). The contract has been secured by a Preston firm of shipbuilders.



CENTRAL MOVING PIVOTS.

TIE. PLATE
GUIDE PLATE
CROSS SECTION OF GROUND
EYE BOLT
HORIZONTAL TIE PLATE
GUIDE PLATE
TIE PLATE

MOUNTING & WORKING OF HEAVY GUNS.

THE acccompanying diagram represents a 7-inch muzzle-loading rifled gun, of 6½ tons, equivalent to a 110-pounder on the usual naval gun slide, or traversing platform, about 12 feet long. These platforms and carriages are now built of iron, and correspond with the sealed pattern known as Mark 2 in Roman characters, technically described as a Frazier gun on Capt. Scott's slide.

The peculiarity here consists of a slight alteration of the position of the ordinary 5 or 6-inch truck wheels, being placed underneath the slide, instead of at the sides, and as nearly as possible under the weight and pressure of the sides of the gun carriage, on which the trunnions of the gun throw the weight of the gun. In order to obtain an unfettered, free, easy movement of the truck wheels, these are made flat and level, without any bevel, or retaining flange; but, instead of these arrangements, a strong guide plate is placed on the inside edge of the wheels, and the truck wheels run smoothly and freely on the smooth upper surface of flat racers, which may be made of any section from a flat plate, or angle iron, or rail, and the guide plate moves in a groove on one side of the racer, which may vary from ¾ of inch to 1½ inches, and may be bevelled back on the lower side to form a dovetail groove, to which the lower edge of the guide plate can be made to correspond by wedge-shaped plates, so that by any upward pressure the guide plate becomes rigidly fixed in the groove when required, by the instantaneous action of an eccentric compressor lever, on the rear end of the slide, and the lateral cross strain between the two guide plates, is met by a tie-plate, as shown in the drawing. The turn rails are formed by bevelled or flanged rings or plates, the flanges, bosses, &c., alternately tapered outwards and inwards, in order to dovetail over and into each other, the whole forming a revolving pivot turning in a socket, and as the wheels on the lower turn rail move along a straight line, the slide turns on these moving pivots as a radius of a circle on a centre; hence, as one end pivot moves along a straight line, the other pivot on a cross line at right angles to the other becomes a fulcrum centre, like the movement of a side-rest (*i.e.* in a lathe), and the slide or traversing platform becomes a lever to move itself round on the pivots, that take always the shortest and most direct route, viz., a straight line, and as all the action of the pivots is confined to straight, intersecting lines, on which any mechanical power can be applied, with the direct action of a straight pull or thrust on a fair lead.

TYNESIDE DREDGERS FOR THE INDIAN GOVERNMENT.

On December 29 the large and powerful dredger, the Nearchus, and two large steam barges, named respectively the Sindi and the Balochi, which have been built by Messrs. Hawks, Crawshay, and Sons, Gateshead, for the Indian Government, were taken out to have their compasses adjusted, and to be tested at sea previous to sailing. The Nearchus is intended to be stationed in the harbour of Kurrachee, at the mouth of the Indus. The opening up of the Suez Canal has brought to this town a large share of the shipping which formerly went almost exclusively to Bombay, and the increase of its commercial importance has called from the Government a development of its harbour accomodation. It is with this view that the Indian authorities ordered the Nearchus, the Sindi, and the Balochi, and the trials they have already undergone on the Tyne indicates the amount of work they will be able to accomplish in one of the most important harbours of India. The name has been chosen under somewhat singular circumstances. Nearchus was the name of Alexander the Great's most famous admiral, who steered the Macedonian fleet down the Indus, and to whom is attributed the first dredging operations recorded in history. According to the chronicler Adrian, when Nearchus sailed down the Indus to its mouth, he found the passage rugged and unsafe through shoals and rocks; but having dug a canal of about five stadia in length where the earth was easiest to remove, as soon as the tide began to rise, he got the whole of his fleet safe over that passage into the ocean. As this dredger is to be employed in further removing the very obstructions which impeded the way of the Macedonian fleet, and which Nearchus overcame by digging a canal, General Hyde, chief of the Engineering Department at the India Office in London, thought it a fitting memorial to the venturous commander to name the new "canal-cutter" after him. Thus the name. The vessel itself is of admirable design and construction. Every line, although gracefully moulded, indicates strength. Few who saw the three vessels steam down the Tyne would suppose from their appearance that they were a dredger and two barges. They seemed more like three well-equipped screw steamers on a voyage to a foreign port. Although the whole contract was given by the Indian Government to Messrs. Hawks, Crawshay, and Sons, the hulls were built to their order by Messrs. Osbourne and Graham, of Sunderland, and these gentlemen have done their part very well. The whole of the iron employed in their construction was manufactured by Messrs. Hawks, Crawshay, and Sons, every plate used being the very best crown boiler iron. The decks, cabin, fittings, &c., are of teak, and substantial in their character. The dimensions of the Nearchus are;—Length of deck (extreme) 160ft.; breadth of beam 28ft.; depth moulded 11ft.; sheer of deck 2ft. 6in.; rise of deck 10in.; draught of water (mean) about 6ft. All the machinery, which in every detail is complete, powerful, and of most finished workmanship, has been made in the works at South Shore, Gateshead, and will uphold the reputation Messrs. Hawks, Crawshay and Sons have so long enjoyed for this class of work. The vessel is fitted with a screw propeller, and the specification was that she should be capable of steaming at the rate of eight miles per hour. The dredging apparatus consists of a single ladder and chain of buckets, working through a well in the centre of the hull, with shoots so arranged as to discharge the *debris* over either side at pleasure. This arrangement is capable of dredging to a depth of 32 feet, and of raising 300 tons per hour. The buckets, which are fitted with strong steel backs, are 34 in number, each having a capacity of 9 cubic feet. The gearing for driving the dredging apparatus is capable of being readily disengaged when the engines are required to drive the propeller, and is arranged so as to work at two different speeds, according to the nature of the material to be dredged, and giving a speed of 12 and 15 buckets respectively per minute, at 75 revolutions per minute of the engines. The motive power consists of a pair of high pressure inverted compound surface condensing engines of 65-horse power (nominal), which are capable either of propelling the screw, as was done yesterday, and will be during the voyage to India, or of driving the dredging machinery. The different winches for lifting the ladder, &c., are worked by separate engines. The boilers are two in number, of cylindrical form, with horizontal tubes, and the specified strength is that they shall be constructed to sustain safely a working pressure of 70lbs. per square inch above the atmosphere, and tested to a double this by hydraulic pressure. Of the heavy gearing the spur-pinions and bevel gearing are of cast steel, and the whole of the machinery is of the strongest possible character. The vessel outwardly is rigged as a two-masted schooner. The capabilities of the Nearchus as a dredger were tried in the Tyne about seven weeks ago, when General Hyde and Mr. W. F. Batho, engineer, Victoria Chambers, Westminster, from whose designs and under whose superintendence the vessels have been built, were present. It was put in work on two consecutive days, and although specified to dredge no more than 300 tons per hour, it raised at the rate of from 300 to 500 tons per hour; and instead of lifting from 10 to 12 buckets per minute it worked up to 17 and 20. The whole trials were satisfactory in the highest degree, and although it was the first time of working not a hitch took place in the machinery. The barges which are to accompany the Nearchus are equal in size, shape, and power. The dimensions of each are:—Length, 130 feet, breadth 28 feet; depth, 10 feet 6 inches; length of hopper, 62 feet. The hopper of each barge is divided into four compartments, and is capable of carrying 400 tons of dredged material. The engines in each are also of the inverted compound surface condensing type, and of 50-horse power (nominal), having a high pressure cylinder of 17 inches, and a low pressure one of 32 inches diameter, with a stroke of 24 inches. They have two boilers of cylindrical form, specified to sustain safely a working pressure of 70 lbs. per square inch. They also, like the Nearchus, are fitted with all the latest improvements in machinery, and are built strongly and compactly. The three vessels left the quay at Messrs. Hawks, Crawshay, and Sons' works shortly after ten o'clock. The Nearchus was gaily decorated with bunting, and as she left the mooring place she was heartily cheered by the workmen on shore. Among those on board were Mr. G. Crawshay, head of the firm, Mr. W. F. Batho, from London, Mr. F. Stanley, and Mr. Henry Charlton, chief engineer at Messrs. Hawks, Crawshay, and Sons. After crossing the bar the Nearchus steamed as far as Whitburn, and as there was a stiff sea on, her sailing capabilities were strongly tested. After the compasses had been adjusted the speed of the vessel was tried, and she went at the rate of 8½ knots an hour, and the engines were working at about 104 revolutions per minute. Everything passed over most satisfactorily, there was not the slightest difficulty experienced with the engines, and the working of all the vessels was admirable. After the trials and adjustment of compasses, the Nearchus and her companions returned to Shields Harbour to take in a supply of fresh water previous to her immediate departure for Kurrachee.

In addition to the three vessels which left the Tyne yesterday, Messrs. Hawks, Crawshay, and Sons have recently sent out to India two dredgers on an entirely different principle. They are built according to a design by Mr. Batho, and are quite different from the ordinary bucket-dredgers. The dredging gear consists of two of Bruce's patent excavators, each capable of containing about five tons of stuff, being so constructed as to open in three sections and dig into the ground, and then to close and grasp the load they are intended to raise. The whole of the motions for raising and lowering these excavators, as well as of opening and shutting them, are performed by hydraulic pressure. The whole structure combines in one a dredger, tug, and fire engine. Before being sent out to India a trial took place in the Tyne, and was remarkably successful. One of them is named Hetty, and the other is as yet nameless. Since having been sent to India the Hetty has been at work, and from telegraphic dispatches that have recently been received in England, its working, in presence of the Lieutenant-Governor of Bengal, has given the greatest satisfaction. The plan which has been found so successful, is likely to inaugurate a new era in dredging operations, not only in this country, but throughout the world.

We may mention that Messrs. Hawks, Crawshay, and Sons are exceedingly busy at the present time. During last year they have sent out three pairs of compound paddle steamers, of 100-horse power each, to the Indian Government, and they have in hand two pairs of similar vessels for the Eastern Bengal Railway Company, which are being built under the inspection of Messrs. Hawkshaw, Son, and Hayter. The firm have other contracts on hand for Russia and other parts of the world, and they have also secured for another term of five years the contract to supply the Admiralty with chains. Their last five years' contract expired in November. Altogether there is work on hand to keep the shops fully employed for a considerable time.

THE THUNDERER GUN EXPERIMENTS.

The final rounds except one in the series of experiments carried out in conformity with the recommendations of the committee appointed to inquire into the cause of a 38-ton gun bursting on board Her Majesty's iron armour-plated turret ship Thunderer, in the Sea of Marmora, were fired at the proof butts in the Government marshes adjoining the Royal Arsenal, Woolwich, on Jan. 16th. The weather was most unpleasant throughout the day, but the attendance of official visitors was nevertheless the largest that has been seen during the experiments, indicating an augmentation of interest as the time approaches for the premeditated destruction of the gun by double loading, which the committee still unanimously consider as the true cause of the disaster.

In order to afford an intelligent account of the series of experiments, and to enable our, readers to form an opinion of what has already been made, we give as briefly as possible a comprehensive digest of the rounds fired up to Jan. 16th in a tabular form ;—

No. of Round.	Air Space.	Charge.	Shell and Weight.		Muzzle Velocity. Feet per second.
1	—	85lb.	Common,	587lb.	1,440
2	—	110lb.	Palliser,	703lb.	1,408
3	1ft.	85lb.	Common,	587lb.	1,272
4	1ft.	110lb.	Palliser,	703lb.	1,311
5	2ft.	85lb.	Common,	586lb.	1,174
6	2ft.	110lb.	Palliser,	679lb.	1,223
7	4ft.	85lb.	Common,	586lb.	941
8	4ft.	110lb.	Palliser,	705lb.	1,018
9	6ft.	85lb.	Common,	592lb.	780
10	6ft.	110lb.	Palisser,	705lb.	876
11	8ft.	75lb.	Common,	592lb.	664
12	8ft.	110lb.	Palliser,	701lb.	754
13	10ft.	110lb.	Palliser,	701lb.	580
14	10ft.	85lb.	Common,	592lb.	536

The main point to be observed was, of course, the pressure produced on the bore of the gun by the powder gases in each case. The pressures in the above rounds were recorded as follows:—

Round.		Round.	
1	20·2 tons per square inch	8	12·8 tons per square inch.
2	21·8 „ „	9	2·2 „ „
3	12·4 „ „	10	8·9 „ „
4	15·2 „ „	11	1·5 „ „
5	9·9 „ „	12	7·4 „ „
6	12·7 „ „	13	6·1 „ „
7	4·0 „ „	14	0·10 „ „

In the last round fired, No. 14, the point of the projectile was some 2ft. from the muzzle of the gun, with an intervening space of 10ft. between the cartridge and projectile. Yesterday was devoted to a trial of what is termed the "wedging" theory, the projectile being jammed in the bore by a papier-mache wad. This theory has been advanced by some who attribute the fault of the explosion to the wad which is usually rammed home after the projectile to secure it in its place. In the opinion of Sir William Palliser, who has been the most prominent advocate of this theory, the wad became displaced by slipping or by the withdrawal of the hydraulic rammer, and was left in such a position as to act as a wedge, and so check the passage of the projectile. Not one of the committee would admit of the possibility of such a contingency, the inference on their minds being that the wad would be blown out of the muzzle by the blast before the shot reached it; and the fact of wooden wedge wads being constantly employed with spherical projectiles, though under somewhat different conditions, was instanced to disprove the notion of risk; but, notwithstanding, a protest was entered before commencing proceedings by Mr. Bramwell, who declared that it had been proved most conclusively by evidence that the wad was fairly against the nose of the shell when the gun was fired, some singular testimony to the fact being afforded by the socket of the wad, which was rent off in the loading. As the wad was having the day to itself, it was naturally the special object of curiosity. It is a disc made of coarse papier-mache, tightly fitting the bore of the gun, and resembling thick millboard, being, in fact, three-quarters of an inch in thickness. The centre of the wad is perforated and occupied by the socket previously referred to, into which the point of the shot enters when the loading is complete. It was rammed into the muzzle with great difficulty, and a naval officer present stated that the gunners had frequently to trim the edges to get it in at all. The powder charge in this, the 15th round of the series, was 85lb., and the shell a common one, weighing 592lb. After these had been sent home, Captain Morley, Royal Artillery, the proof officer who conducted the experiments, carefully placed one of the wads in the gun 5ft. in front of the shot, and with a wedge-headed hammer made for the purpose he canted it over to an angle of 45 degrees, in such a position that if it remained there it would be likely to jam between the shot and the gun. The spectators were well protected from the consequences of the threatened burst, for the gun had been run back into the recesses of the bursting cell which it has occupied during the trials, and which was built for the purpose, and not only had the whole of the embrasures 40ft. to the front been strongly roofed in, but, after allowing a narrow opening for the escape of the powder gases and smoke, the enclosure had been continued by a gallery or tunnel 50ft. long, designed to prevent the lateral escape of fragments of the gun, and appropriately named the "splinter-trap." This was built up of baulks of timber 14in. thick, weighted above and battened on either side by sand-bags, of which no less than 5,000 were employed in its construction. Colonel Noble, Royal Engineers, the Inspector of Works at the Royal Arsenal, Woolwich, by whom the same was erected, explained that it was of a temporary character, for a temporary purpose, and that, as it would be heavily strained when the gun was fired, it would not endure many rounds, as the result proved. The gun was fired in the usual way, by electricity, and the gallery was found to be so much shaken that entrance to it was forbidden. Access to the gun was, however, obtained from other points, and it was found, as generally anticipated, unhurt. An adjournment for about two hours followed, during which time the Royal Engineers repaired the splinter trap under the direction of Captain O'Brien, Royal Engineers, and Lieutenant M'Callum, Royal Engineers, Assistant Inspector of Works, and proceedings were then resumed in the rain and the mire. The second part of the wedging theory has been that the wad was displaced but not canted, and that, being suddenly struck by the pointed projectile, it doubled up and jammed in both sides. To try this fancy the wad was simply left in Round No. 16 at a distance of 5ft. from the shot and in its proper vertical position. The charge and shell were similar to the last, except that the latter weighed a few pounds less. Opinions were expressed that the wad would be instantly blown out by the compression of air without reckoning the blast, but, whether this was so or not, no injury happened to the gun, and the wad, as in the preceding round, was found in small fragments all the way to the butts.

The sanction of the Secretary of State to the crucial trial is now awaited, and in about a few days the work of the committee will in all probability be finished, and the confidence of the Navy and the nation in their guns restored by showing that in no circumstances, except such as are easiest avoided, is there the slightest danger of their bursting.

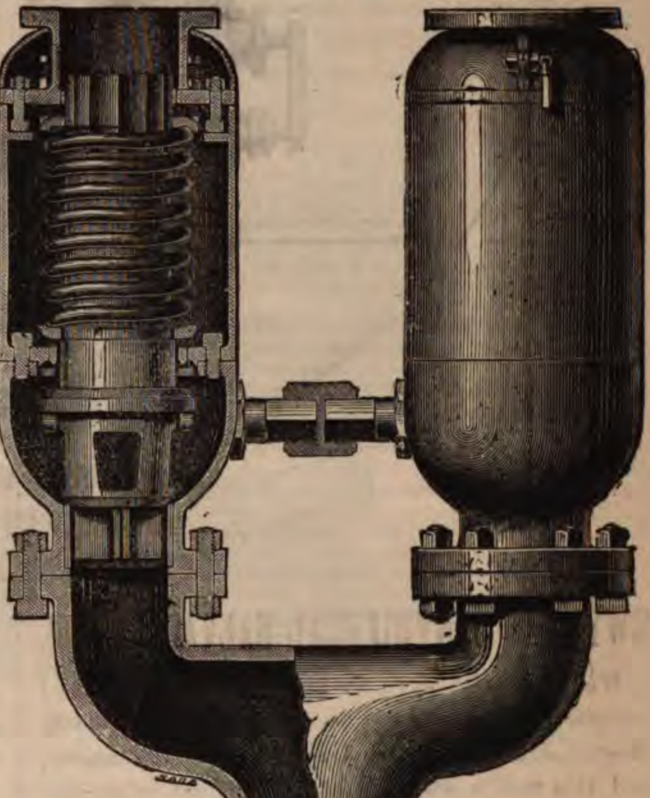
SMITH'S PATENT SAFETY VALVE.

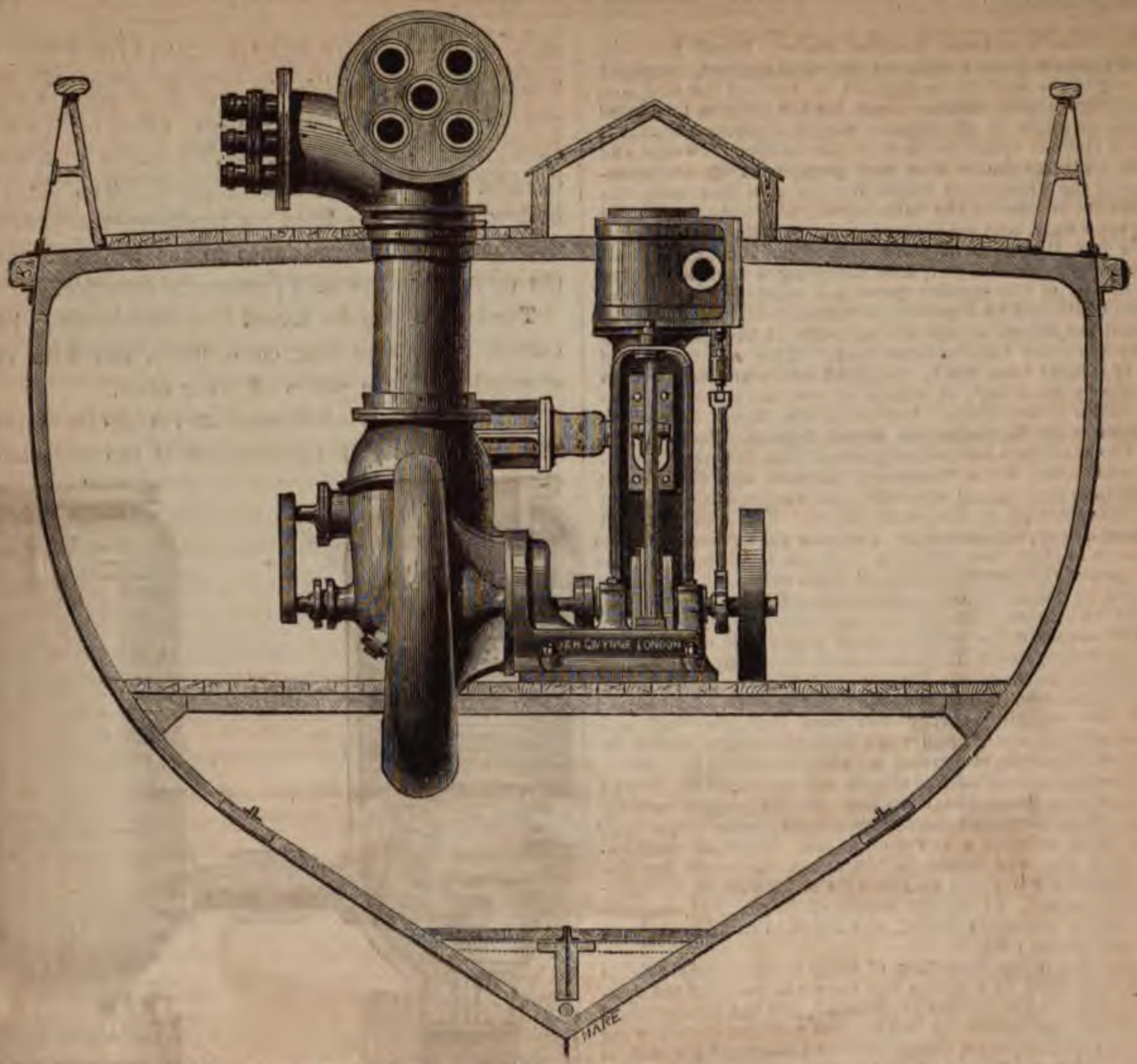
A perfect safety valve is a great treasure in any boiler—more particularly in marine boilers. Where the spindles and seats of valves are subject to corrosion, too much care cannot be used to apply as many precautions as possible against excess pressure in the boiler. There is no doubt, in our opinion, that spring valves must be eventually not only freely admitted, but preferred for use at sea to all dead load safety valves.

The construction of this valve, patented by the late Mr. Smith, and now in the hands of Messrs. W. Thompson & Co., of Queen Victoria Street, is easily seen from the engraving. The valve, of the ordinary mushroom type, is surmounted by an open hollow spindle, into which the steam escaping from the valve seat passes. The escaping steam thus gets a direct thrust upon the spring from the centre, and by the rapid compression thus produced gives immediate relief to the boiler. The steam, passing through the hollow spindle, is hereby prevented almost entirely from affecting the spiral spring, which is, however, further coated with copper to resist any possible corrosive action. The valve and hollow spindle are fitted on the knife-edge principle, thereby preventing resistance to the action of raising the valve when the fixed pressure is exceeded.

The valves may be moved from their seatings by an outside lever operating on spindles, and with claws attached to lift the valves off their seats.

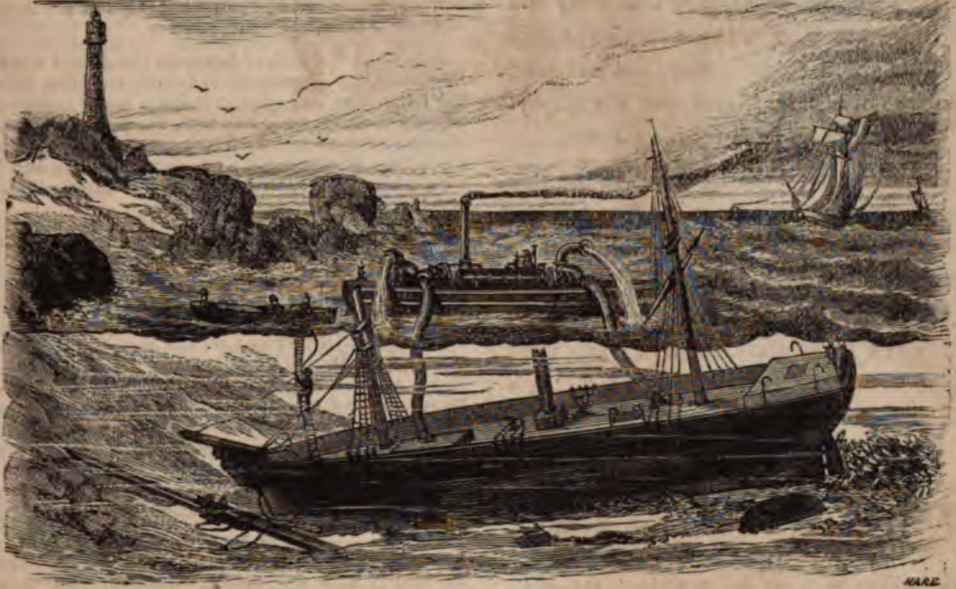
There is a ready adjustment at the top by means of set-screws, got at by the removal of the top case, so that the valve can easily be set or readjusted to blow off at any required pressure. At the same time, when this top case is secured by a padlock, it is impossible for anyone not holding the key to tamper with the blowing-off pressure of the valve under any circumstances. We would direct attention to the fact that any spring valve in which the spring can be seen or reached from the outside, may be successfully tampered with to prevent blowing off, and in some cases the lifting lever can be used for the same purpose. In neither of these ways can Smith's valve be tampered with.





GWYNNE'S CENTRIFUGAL SALVAGE PUMP.

We last month gave an illustration of a combined centrifugal pump and engine, as designed and made by Messrs. John and Henry Gwynne, of Hammersmith, and this month we illustrate an adaptation of this pumping engine to salvage purposes, by the same firm. Fig. 1 is a cross section of a tug, the Abeille (see page 193 MARINE ENGINEER, Jan. 1, 1880, of launch), that has just been built by Messrs. Cunliffe and Dunlop, of Port Glasgow, to the order of a firm in Havre. She is an iron twin screw tug steamer, and, when necessary, can be used for salvage purposes, or as a powerful fire engine. This engraving shows the mode of fixing the pump. Fig. 2 shows these pumping engines placed on board a barge employed in pumping the water or grain out of a sunken ship. This plan is adopted by most of the Salvage Companies. In the arrangement (Fig. 1) to facilitate the fixing of the connections, both the suction and delivery pipes (which are arranged to swivel) are brought on deck; the suction pipe has five nozzles, to each of which a separate hose may be attached, so that, if necessary, water may be drawn from five different compartments at the same time. The water may be delivered on deck or overboard through one delivery-pipe, or when it is desired to use the pump as a fire-engine, a readily fixed plate is attached to the delivery-pipe, the pumping engine in question has five similar nozzles to those on the suction pipe, to each of which a 3-in. hose may be attached. The pump is powerful enough to supply five 1¼-in. jets, and thus a large body of water can be thrown. In fires aboard ships it is not necessary to project the water to any great height, but quantity is the great desideratum, so that a centrifugal pump is admirably adapted for this purpose; it has also an additional advantage, there is no risk of bursting the hose through its kinking, or twisting, as the pressure can never exceed that due to the diameter and speed of the pump, and if the delivery is entirely stopped it is considerably less. This makes the Invincible pumping engine particularly valuable as a bilge pump, and for washing decks on board steamers; these pumping engines have, we believe, been fitted on board all Mr. Alfred Holt's China steamers for above purposes. The small hose easily handled, can be speedily connected or disconnected, if necessary by one or two men, whereas a large suction or delivery pipe would probably require several, and in most instances would not be so convenient.



We have had the pleasure of seeing a large number of these pumps and engines under construction at Messrs. Gwynne's works, of various designs, to suit the purpose for which they are intended, and were much impressed with the completeness with which the details have been worked out, and the generally satisfactory manner in which they are made. In most instances the engine and pump are fixed to one substantial bedplate, the pump being bolted to a turned and bored faceplate flange, in such a manner that it can be swung round so as to bring the suction and delivery flanges into any desired position, without any risk of throwing it out of truth. The bolts which fix it have ┳ heads, which fit into a concentric groove in the faceplate flange; the side of the pump casing farthest from the engine can be easily removed so as to get at the disc without disturbing any other portion of the engine, pump, or connection. Most of them have an air exhauster attached, which is readily connected or disconnected, so that any air which might interfere with its satisfactory working can be removed, and this also dispenses with the use of a foot valve. For marine purposes the disc and spindle are usually made of gunmetal, and sometimes the casing itself. The engines are of good design, the piston and crosshead being in one, and with the connecting rod, eccentric rod, valve spindle, and crank shaft, are of steel. The latter is cut out of one solid forging, carefully counter-balanced, and provided with double bearings. All the bearings have ample surface, and great pains have been taken to obtain efficient lubrication whilst running at high speeds; the mode of lubricating the crank pin being specially noticeable. A small passage is drilled from the crank pin, passing through one of the crank webs, and centre of shaft, to its free outer end, where a swinging lubricator is kept in a vertical position by an underneath balance weight, the centrifugal force when the engine is running draws the oil from the lubricator through the passage to the crank pin. All the other bearings of the engine and pump are supplied from one oil-box.

The cylinders are made large enough to drive the pumps at a high velocity when lifting, say, 30ft. working non-condensing and with a moderate boiler pressure; but as the exhaust pipe is usually connected to the condenser when fixed for marine purposes, the full condenser vacuum increases its power, the lift is generally considerably less, and the initial pressure in the cylinder in ordinary working is often only a very few pounds above atmospheric pressure, so that a large reserve of power is available at any time for increasing the speed of the pump, and as a consequence the weight of water discharged overboard, and by turning the suction on to the bilge, a serious leak or sudden inrush of water from any cause can be instantly dealt with. They are also used for pumping out the ballast tanks, and for this purpose are vastly superior to the ordinary donkey pumps, being more economical noiseless, less liable to get out of order, and as there are no moving valves, are more certain, and less liable to choke up.

It speaks well for this firms' engines and pumps, that they are now supplying them to most of the largest steam ships afloat, to our home and most foreign navies, after having overcome the undoubted prejudice which most marine engineers had against them, they are now commonly fitted as the sole means provided for circulating the condensing water, and large numbers of them have worked satisfactorily for years, costing little for repairs, and with almost a total absence from break downs. Amongst others, we understand that they are now making three for the Servia, the new 5,000 tons Cunard liner, two for circulating the water and pumping from the bilge in case of accident, and one for emptying the water ballast tanks and for washing decks.

The recent narrow escape of the Eldorado in the Bay of Biscay has impressed upon the large Mail and Steam Ship Companies the necessity for providing ample independent pumping machinery in the most accessible position. Messrs. J. and H. Gwynne have received the order to fit the ten large steamers now being built for the French Transatlantique Company in this country with the "Invincible" pumping engines, one to be fitted on the deck of each steamer. Where the engineers must perforce go when they are drowned out from below by any sudden inrush of water, and they anticipate that, though the fires may be quenched, the boilers will retain sufficient steam to keep this pump at work for some time, or if the donkey boiler should happen to be at a higher level, steam could be supplied from it, so that an opportunity might be afforded for finding out the cause of the leak and stopping it, or if the water arose from shipping seas, the ship might possibly be cleared and the fires relighted. A somewhat similar arrangement has been fitted on board Messrs. Donald Currie and Co.'s two new Cape mail steamers.

This Firm recently constructed eight large pumps, and four engines to drive them, for draining the Farrara Marshes, in Italy; these pumps at their trial ischarged 2,100 tons of water per minute, and last nter they worked continuously without any hitch, t and day, from October 10th to May 6th.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial ships, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES (ENGLISH.)

Nora.—On December 22nd the Nora steam yacht was launched by Messrs. C. Mitchell and Co., on the Tyne. The vessel is to take the place of a yacht of the same name which was wrecked at St. Mary's Island in the spring of this year. The present Nora is of considerably increased dimensions, and is as follows:—Length between perpendiculars, 170 feet; breadth of beam, 26 feet; depth, 15 feet. She is to take the highest class at Lloyd's. The engines are by Messrs. R. and W. Hawthorn, of Newcastle, and are constructed on the compound surface condensing system, and will burn an extremely small quantity of coal, while the vessel, from her fine lines, is being propelled at the rate of 11 knots per hour. The Owner is Mons. Perret, a French senator.

Asia.—On the 10th of January, the Asia, built for E. Carr, Esq Hamburg, by Messrs. C. Mitchell and Co., Low Walker, on the Tyne, was launched. She is a screw steamer, built of iron, capable of carrying 2,200 tons deadweight, and is fitted with all the most recent appliances for economy and efficiency in working. She is in all respects a sister vessel to the Europa, which was constructed by Messrs. Mitchell and Co. for the same owner.

Stakesby.—On the 12th Jan. there was launched from the shipbuilding yard of Messrs. Joseph L. Thompson and Sons, North Sands, Sunderland, an iron screw-steamer of 1,900 tons burthen, built (under special survey to class 100 A 1 at Lloyd's) to the order of Mr. John H. Barry and Partners, of Whitby, This vessel will be fitted with a pair of compound surface-condensing engines, of 130-horse power nominal, by Mr. John Dickinson, of Sunderland. She is constructed with water ballast in the fore and aft holds, which are also divided into six watertight compartments; four horizontal steam winches, by Rogers, of Stockton, and Harfield's patent windlass. The ceremony of naming the vessel Stakesby was performed by Miss Barry, of Whitby. The Stakesby is intended for the Mediterranean and Baltic trades.

Lady Tyler.—On the 12th Jan. a paddle passenger steamer was launched from the shipbuilding yard of Messrs. T. and W. Smith and Co., North Shields. This steamer has been built to the order of the Great Eastern Railway Company for their Continental traffic between Harwich and Rotterdam. She is 260 feet long, 30 feet beam, and the depth is 13 feet 6 inches and 7 feet three inches. Her registered tonnage will be 1,150 tons. Her complement of passengers will be 200, and her engines, 350-horse power, are to be fitted by Messrs. R. and W. Hawthorn. It is expected that the Lady Tyler will be ready for her trial trip in about two months time.

Good design.—On Jan. 13 a fishing yawl was launched from the yard of the Whitby and Robin Hood's Bay Graving Dock Company. The vessel is about 42 tons register, and is intended to form the first of a series of high-class fishing boats. She was christened Good Design by Mr. W. Thompson, one of the owners.

Author.—On the 15th inst. there was launched from the shipbuilding yard of Messrs. C. Mitchell and Co., Low Walker, a vessel of the following dimensions:—Length 250 feet, beam 32 feet, depth 21 feet. She is built to class A 1 at Lloyd's, to the order of Messrs. T. and J. Harrison, of Liverpool, by whom she will be employed in their general trades to the West Indies and South America. The vessel, which was named the Author, was, immediately after the launch, taken to the Wallsend Slipway and Engineering Company's works, Wallsend, by whom she will be fitted with compound engines of the latest type.

Muriel.—On the 26th Jan. there was launched from the yard of Messrs. Raylton, Dixon, and Co., Middlesbrough, a screw steamer, named the Muriel, which has been built to the order of Messrs. Rayner and Murray, of Middlesbrough. Her dimensions are:—250 feet long, 33 feet beam, and 17 feet 9 inches depth of hold. She is built with long raised quarter deck and cabins under the bridge; her decks are of iron, and she has four steam winches and all modern improvements. Her carrying capability is about 1,840 tons, and she will be fitted with engines of 120-horse power by Messrs. Thomas Richardson and Sons, of Hartlepool. On leaving the ways she was christened the Muriel by the daughter of Mr. Murray, one of the managing owners.

LAUNCHES (SCOTCH).

Bellver.—On 22nd December the Bellver was launched from the yard of Messrs. James and George Thompson, at Clydebank, Glasgow. She is an iron screw steamer of 1,200 tons and 200-horse power, built to the order of Mr. Thomas Raison, London, acting for Senor Bauls, of Palma de Mallorca.

Billiton.—On the 29th December, Messrs. Blackwood and Gordon launched from their yard at Port Glasgow a screw steamer of the following dimensions:—Length of keel and fore-rake, 160 feet; breadth of beam, 25 feet; depth of hold, 9 feet; and the tonnage B.M., 482. The engines, which will be supplied by the builders, are of 75-horse power nominal, and are compound surface-condensing. The vessel has been built to the order of Messrs. Adamson, Gilfillan, and Co., London, for Lee Keng Yong, of Singapore, and is intended for the passenger traffic between the islands around Singapore, and with this object she has been constructed without a keel, so as to enable her to sail in shallow water. As the vessel left the stocks she was named the Billiton by Miss Ferguson, daughter of the Superintending Engineer.

Resolute.—At Dundee on the 29th December there was launched by Messrs. Alex. Stephen and Sons a screw whaler, named the Resolute, whose dimensions are:—Length, 175 feet 6 inches; breadth, 30 feet 8 inches; depth of hold, 18 feet 6 inches; and 680 tons gross. She has been built for the Dundee Seal and Whale Fishing Company, and Captain Yule, formerly of the whaler Esquimaux, has been appointed commander. She is classed A 1 at Lloyd's for ten years. The vessel will be barque-rigged, and will be fitted with engines of 96-horse power, and also with tanks capable of holding 350 tons of oil. She, in company with four other of the Dundee fleet, will leave for St. John's (N.F.) to prosecute the seal fishing.

Firth of Dornoch.—On 10th January there was launched from the shipbuilding yard of Messrs. Russell and Co., Cartsdyke, Greenock, an iron sailing barque of 900 tons. She is 200 feet in length between perpendiculars, 32 feet 6 inches broad, and 19 feet in depth. As she left the ways she was named the Firth of Dornoch by Mrs. Hayes, wife of one of the owners. The vessel is intended for general trading, and has been built to the order of Messrs. James Spencer and Co., Glasgow. After the launch the new barque was towed up to the harbour at Port Glasgow, where she will be fitted out.

Vagliona A.—On the 10th January Messrs. Thomas B. Seath and Co. launched from their shipbuilding yard at Rutherglen an iron twin screw steamer of the following dimensions:—175 feet in length and 27 feet beam. The machinery, which is supplied by Messrs. A. Campbell and Son, Anderston Quay, Glasgow, consists of a pair of compound engines of 50-horse power. On leaving the stocks the vessel was named the Vagliona A by Miss Jane Smith, daughter of the builder. The Vagliona A is the first of two steamers being built by the Messrs. Seath for Messrs. Vagliona Brothers, of London. The vessels are intended for the grain trade on the Danube, Don, and Black Sea. The Vagliona A is built with seven watertight compartments, and is fitted up with steam winches and all the recent improvements for the rapid loading and discharging of grain cargoes. The companion steamer, which is to be named the Vagliona B, is being rapidly pushed forward, and will be ready for launching in the course of a week or two.

Fokien.—On the 12th January there was launched from the building-yard of Messrs. Hall, Russell, and Co., Aberdeen, an iron screw steamer, named the Fokien, of the following dimensions:—Length, 210 feet; breadth, 29 feet; depth, 21 feet; and 850 tons gross. This vessel has been built under special survey, and classed A 1 at Lloyd's, and will be fitted with compound surface-cendensing engines of 135-horse power nominal, steam winches, water ballast, patent windlass, and all the most approved appliances for facilitating the loading and discharging of cargoes; and has accommodation for about 50 first-class European passengers, and 250 steerage passengers. The Fokien hasbeen built to the order of Messrs. Douglas, Lapraik, aud is intended for the China coasting trade, where she will be commanded by Captain Ashton. As the vessel left the ways she was named Fokien by Miss Couper, and was afterwards taken to the sheer poles for the purpose of receiving masts and machinery.

Montgomeryshire.—On the 13th January the London and Glasgow Engineering and Shipbuilding Company (Limited) launched from their shipbuilding yard at Govan an iron screw steamer, built to the order of Messrs. Jenkins and Co., of London. Her dimensions are 330 feet by 35 feet 6 inches, by 25 feet 8 inches, and class 100 A 1 at Lloyd's. She will be fitted by the builders with a pair of compound surface-condensing engines of 300-horse power nominal, and is supplied with all modern improvements, including steam steering gear, Napier's steam windlass, &c. The vessel was, as she left the ways, named Montgomeryshire by Miss Reid, Ibroxhill.

Taramung.—On the 13th January Messrs. Russell and Co. launched a screw steamer of the following dimensions:—Length, 249 feet; breadth of beam, 33 feet 6 inches; depth of hold, 16 feet 6 inches; and about 1,300 tons. The engines, which are to be 130-horse power, will be supplied by Messrs Kincaird, Donald and Co., Greenock. This steamer, which has been named the Taramung, has been built to the order of ex-Mayor John M‘Ilwraith, of Melbourne, and is to be engaged in the Australian trade. When fitted out the Taramung will be taken to Glasgow, where she will load for Melbourne.

Loch Garry.—On the 13th January an addition was made to the Loch Line of steamers belonging to Dundee, and managed by Messrs. Ireland, Leitch, and Co., by the launching from the shipbuilding yard of Messrs. Gourlay Brothers and Company, of Dundee, of a fine iron screw steamer of 960 tons gross register. Her dimensions are:—Length, 210 feet; breath of beam, 29 feet 6 inches; depth in hold, 15 feet 9 inches. She will be fitted with compound surface-condensing engines of about 98-horse power nominal. Her boiler will be of steel, and she will also have a steel crank shaft and steel hawsers, the ordinary hempen mooring gear being dispensed with. As she left the ways the vessel was named the Loch Garry by Miss Rodger, daughter of Mr. Rodger, of the firm of Messrs. Rodger and Whyte, tea merchants, Castle-street. The Loch Garry has been specially designed as a cargo-carrying boat, and will be engaged in the Baltic trade principally. She is the fourth steamer of the line built for Messrs. Ireland, Leitch, and Co. by Messrs. Gourlay Brothers and Co., and the fifth is expected to be launched in about three weeks. After the launch a party of ladies and gentlemen met in the drawing loft, where cake and wine was served and several toasts proposed. "Success to the Loch Garry" was given by Mr. Henry Gourlay, and the toast was acknowledged by Mr. Leitch, of the managing firm. The toast of Messrs. Gourlay Brothers and Co. was proposed by Mr. Pirie, and responded to by Mr. Gershom Gourlay. "The Ladies," coupled with the name of Miss Rodger, who performed the christening ceremony, was given by Mr. Matthewson, and replied to by Mr. Rodger. The company then separated.

Scotia.—On the 14th January the Messrs. H. M‘Intyre and Co. launched from their shipbuilding yard at Merksworth, Paisley, the largest paddle-steamer which has ever been built on the banks of the River Cart. The vessel is 212 feet long, 21 feet 6 inches broad, and 8 feet deep. She has been built to the order of Captain Wm. Buchanan, the owner of the Eagle, Brodick Castle, and several other river steamers; and she is intended to run between Glasgow and Rothesay. The steamer, as it left the ways, was named the Scotia by Mrs. George Buchanan. The vessel was immediately taken in tow by a tug steamer and proceeded to Glasgow, where she will be fitted with a pair of powerful steeple engines by Messrs. William King and Co.

Jeune Amiral.—On the 15th January there was launched, from Messrs. Dobie and Co.'s yard, Govan, a screw steamer of about 500 tons measurement, built for the Brazilian trade to the order of foreign owners. As the vessel left the ways she was named Jeune Amiral by Mrs. Johnson, of Colphino, Patrick-hill. The machinery for this vessel is being supplied by Mr. Wm. Kemp, engineer, Govan.

Lizzie.—On the 19th December the Campbeltown Shipbuilding Company launched from their yard at Trent Point, a cutter of 50 tons, built to the order of J. B Lindsay, Esq., of Irvine. The vessel was named Lizzie by Miss Jennie Colville, youngest daughter of Robt. Colville, Esq., of Rochbank.

Fantee.—On 24th December Messrs. Alex. Stephen and Sons launched from their yard at Linthouse the Fantee, a twin screw steamer 120 feet long, built of Siemen's steel, and specially designed for trading in shallow rivers, being capable of carrying cargo on a very light draught. The vessel was fitted before launching with two pairs of compound engines giving together 50-h.p. nominal.

Vagliona B.—On the 24th January Messrs. Thomas B. Seath and Co. launched from their shipbuilding yard at Rutherglen an iron twin screw-steamer of the following dimensions:—175 feet in length, 27 feet beam, and 6 feet 9 inches in depth. The vessel is intended for the grain trade on the Danube, Don, and Black Sea, and is specially fitted up for the trade, being built with seven water-tight compartments, and also supplied with steam winches and all the most recent improvements for the rapid loading and discharging of cargoes. The machinery, which consists of a pair of compound engines of 50-horse power, is supplied by Messrs. A. Campbell and Son, Anderston Quay, Glasgow. On leaving the ways, the vessel was named the Vagliona B, by Miss Campbell, Glasgow, daughter of Mr. Campbell, engineer. The Vagliona B is a companion steamer to the Vagliona A, launched three weeks ago by the same firm for Messrs. Vagliona Brothers, of London.

Rambler.—Her Majesty's gunboat Rambler was launched on the 26th January from Eden's-yard. Govan. Her length is 157 feet, breadth 39½ feet, and depth 14½ feet; displacement tonnage, 774. Her engines indicate 750-horse power. She is steel plated and planked with a double thickness of teak, and is copper-sheathed to water line. She will carry 64-pounder muzzle-loading rifled bow and stern chasers, and broadside of 4½ tons.

TRIAL TRIPS.

Conqueror.—The new twin screw steam tug Conqueror, belonging to the Clyde Shipping Company, had a trial-trip on 31st December, on the Clyde, starting from the Old Steamboat Quay at Greenock. The Conqueror, which is a vessel of a very handsome model, and presents the appearance of a yacht rather than of a tug steamer, is 122 feet long, with a breadth of beam of 21 feet and a depth of hold of 11 feet. Her gross tonnage is about 184, and net 47. The peculiar feature of this steamer is that she has been supplied with vertical, two-cylinder disconnecting compound screw engines of 70 horse-power. These have been supplied by Messrs. Rankin and Blackmore, Greenock, and the patent is that of Mr. Rankin himself. The chief advantage of this patent is that, instead of having four cylinders, there is only one high and one low pressure cylinder. In addition to many other improvements, the Conqueror has a tubular steel boiler, which works up to 80 lbs., together with somewhat of a novelty in the windlass, which, besides working the cables, has all the advantages of an ordinary steam winch for lifting weights, cargo, &c., to the extent of about four tons. The enginehouse, instead of being covered as usual with an ordinary skylight, is surrounded by an iron house, the upper part of which forms a promenade deck capable of accommodating 200 persons when acting as a tender. The mast is composed of steel. She has got a large hold forward, which can be used in attending wrecks, and is capable of containing auxiliary boilers and other works. This hold can take in 100 tons of coal. One of the advantages of the twin screw system is that if one of the engines goes wrong, the other is able to propel the vessel, at more than half the usual speed. When the boat had reached the measured mile at Largs, several runs were made, when it was ascertained that the speed attained was close upon 11½ knots an hour. The number of revolutions per minute were 92. The dimensions of the cylinders are respectively:—High pressure cylinder, 21 in. in diameter; and low pressure cylinder, 40 in., with a piston stroke of 26 inches. The indicated horse-power is 430. There are three furnaces. The company on board expressed themselves as well satisfied with the trial. We believe that the Conqueror will be under the command of Captain John Morrison, presently of the Flying Foam.

The Grandtully Castle.—The new screw steamship Grandtully Castle, of 3,600 tons, built by Messrs. Barclay, Curle, and Co., Glasgow, for Messrs. Donald Currie and Co., of London and Leith, went down the Clyde 31st Dec. on her official trial trip. The vessel ran the measured mile below Wemyss bay, making 14½ knots, equal to 16½ English miles, with 61 revolutions per minute, and a pressure of steam of 75 lbs. It was remarked that the speed attained is within a fraction of that made by the steel ship Kinfauns Castle, also belonging to Messrs. D. Currie and Co.

The Cosmos.—On the 6th Jan. the official trip of the paddle steamer Cosmos took place with gratifying results, the speed attained being 15 knots per hour. This steamer, built for the Mensaceries Fluviales á Vapor of South America, presents some features of striking novelty. Her hull is of steel, manufactured by the Steel Company of Scotland, and by the use of this material the builders have been able to construct the vessel to sail in the light draught necessary for the navigation of the River Plate, without curtailing the elaborate arrangements for the accomodation of passengers or diminishing in the least degree her structural strength. The dimensions of the Cosmos are:—Length, 250 feet; breadth, 29 feet; over sponsons, 33 feet; depth, moulded to main deck, 11½ feet; gross tonnage, 1,003 tons. The vessel is lighted by eight electric lamps on the Jablochkoff system, thereby ensuring the maximum of illumination with the least possible heating of the cabin. The effect of the lamps was much approved by the guests at the trial, and the extension of their use in steamers was confidently predicted by several gentlemen interested in shipping. The Cosmos is fitted by Messrs. Brown Brothers, of Edinburgh, with a complete set of hydraulic apparatus, comprising reversing gear for the main engines, warping capstan, steering gear, and cranes for loading and discharging cargo.

Derwent.—On Jan. 10 the new mail steamship Derwent, built by Mr. Robt. Thompson, Southwick yard, Sunderland, for the Royal Mail Steam Packet Company, London and Southampton, left this port for the latter place. The Derwent is a vessel handsome in design and well constructed. She is intended for carrying mails and passengers as well as cargo between this country and Brazil, and is admirably adapted for this service. She is the first vessel built in this port for the Royal Mail Company, and we venture to anticipate that she will give every satisfaction to the owners, and sustain the high character of Sunderland as a first-class shipbuilding port. Her principal dimensions are—length 330 feet, breadth 36 feet, and depth 25 feet 6 inches, her gross tonnage being 2,500. She is classed 100 A1 at Lloyd's, and has been built in excess of Lloyd's requirements. The North-Eastern Marine Engineering Company have put in the engines, which are on the compound surface condensing principle, of 350-horse power, and with cylinders 42 by 73 by 48 inch stroke. They worked smoothly and steadily at sea on Saturday and gave the greatest satisfaction. Mr. Allen, manager of the well-known company who fitted them, will superintend their working as far as Southampton. The safety of the vessel at sea has been made as complete as possible. Six watertight bulkheads have been constructed in her, and the protection thus afforded is such that no matter where she may be holed she will not sink. The Derwent can carry water ballast in the fore and after holds, and the pipes are so arranged that the water can be pumped out either by steam or manual power. In each hold there are Downton's patent pumps. A donkey engine is placed on the upper deck amidships, and there are four steam cranes and two steam winches, all of which can be worked at the same time if necessary. Care has been taken so as to lessen the noise which they will cause as much as possible to the passengers. In windlasses, large derrick booms, &c., she is properly found, and in all appliances for working the vessel or cargo, only those on the best principles have been adopted. She is rigged as a three-masted schooner, and has Colling and Pinkney's patent self-reefing topsail.

Trial Trip of the Wallasey Steamer Sunflower—Although the above steamer, newly built for the Wallasey Commissioner, has been for some time in the Mersey, the authorities did not think it necessary to test her capacity until January 19th, when at 2·30 p.m. she left the Seacombe stage, having on board only four commissioners, Messrs. Nelson, Walmsley, Skinner, and Ellis, the ferry manager and foreman engineer, and a few non-official visitors, amongst whom we noticed the chairman of the Seacombe [Ratepayers Association, Mr. C. Birchall. Of her carrying capacity as a luggage boat (for which she is intended) no adequate idea can be formed from this trip, as not only had she no load on board, but there was no sea on to test how she would behave in heavy weather and when carrying a heavy deck load. In that respect we must only hope for the best. Of her steaming abilities there can be no doubt, for with engines of only two thirds the horse power of either of the new passenger boats Primrose and Daisy, she nearly, if not completely equals them in speed, indeed, from her lines we would expect this. The Sunflower was built by Messrs. Seath, of Rosherglen, and supplied with diagonal oscillating engines of 60-horse power (nominal) by David Rowan, of Glasgow. She is 140 feet long, 26 feet wide, and 9 feet deep, and draws, when coaled, 5 feet 2 inches., without coal 5 feet. She is supplied with a sponson deck, running fore and aft the whole length of the boat, and on the deck are laid two lines of iron rails for waggons, carts, &c., which are intended to be received, end on, after being placed on the stage by the hydraulic lift. She possesses good accommodation for her crew, but none whatever for passengers, of which she is certificated to carry 998. We presume she may be used on a holiday emergency. She proceeded as far as the Crosby Light Ship, and returned to Seacombe about 5.30, having attained a speed of nine and three-quarter knots. If when she is heavily loaded she is not extremely crank, we opine that she will satisfy all the requirements of the Wallasey ferry traffic for a long time to come.

Engadine.—The trial of the screw-steamer Engadine, which has been built by Palmer's Company for Messrs. Wilson and Co., of London, took place on Jan. 15. The dimensions of the Engadine are: Length, 240 feet; breadth, 33 feet; depth, 18 feet; her carrying capacity (deadweight) being 1,850 tons. The vessel has iron decks throughout, and she is supplied with steam winches, and all other recent improvements whereby she can be easily and economically worked. After the trial run the steamer returned to the Tyne, and was moored in Shields Harbour, to take in a general cargo for the Mediterranean and Constantinople.

Superb.—The trial trip of the armour-plated ship Superb, 16 guns, 8,760 tons, 7,430-horse power, which was made on January 15th, at the measured mile off the Maplin Sands, proved very unsatisfactory, and before another trial is made she will have to return to Chatham Dockyard and have various alterations made.

S. S. Tinonee.—The following is taken from a Sydney newspaper:—In order to keep pace with the increasing shipping trade to the northern ports of Queensland, the Australian Steam Navigation Company have recently had some most extensive alterations and improvements effected on the Tinonee, so as to make her more efficient and better adapted for the requirements of the trade between Brisbane, Port M'Kay, and Bundaberg. The ship has had her hull thoroughly strengthened, and she has been renovated throughout to such an extent as to make her almost a new ship. The most important and the most successful alteration has been the removing of the old engines and the fitting of a pair of Rankin and Blackmore's patents, which are designed for twin-screw vessels, and are the first of the kind introduced into the colony. The high-pressure cylinder drives one screw, and the low-pressure tne other one, instead of having, as formerly, a high-pressure and a low-pressure to each propeller. These new engines can be worked separately or collectively, and by the arrangement of differential and escape valves the engines work with equal power, and are particularly handy. With the former machinery a speed of seven knots only could be got; but yesterday on the trial an average of ten knots was obtained with a boiler power of 65lbs. to the inch, though the consumption of fuel was not increased. The ship left the Australian Steam Navigation Company's works soon after 11 o'clock, in command of Captain Williams, and having on board Captain Trouton, Mr. George Davidson (the company's superintending engineer), and Mr. Broderick (the Government inspecting engineer). The vessel steamed a few miles to sea, and was timed both out and home, and throughout, the action of the machinery gave every satisfaction; and, besides the boiler which has been constructed at the Company's works, a new four-bladed propeller has been fitted, and the ship is now in the most complete sea-going order. Mr. Davidson has for some time past been most favourably impressed with Rankin and Blackmore's engines, and at his suggestion they were imported and introduced into the Tinonee. Their success will, no doubt, be the means of their introduction to other twin-screw steamers belonging to the company. The ship will take her departure for Queensland under Capt. William's command.

Correspondence.

*[It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.—*Ed.]

IMPROVEMENTS FOR SAVING OF FUEL IN STEAM SHIPS.

To the Editor of the Marine Engineer.

Sir,—As your correspondent, "Ship Owner," is desirous of information from "practical sea-going Engineers," and through the medium of your valuable paper (which, by the way, should be in the hands of every practical engineer and apprentice) I am pleased to recommend his attention to a patent by Mr. Vial, of Southampton, for improvement in compound engines. I have seen the "Model" at work, and feel confident that a large pair of engines on his principle will give most economical results. The "compression," or resistance, on back of high pressure piston is rendered *nil*, and he works the steam very expansively in the low pressure cylinder. Without the slightest trouble, he works his engine high prsssure, besides having many other advantages in case of a "breakdown." Should your correspondent think my remarks of any value, he had better put himself in communication with Messrs. Oswald and Mardaunt, Engineers and Shipbuilders, Woolston, Southampton, who would, I am sure, [give him such information as he may require. I do not know Mr. Vial's address, else I would enclose it.

With regard to the latter part of "Ship-owner's" letter, I may say that the elaborate experiments carried out by the United States Engineers settled beyond doubt that simple expansive engines are not so economical as the "Compounders." I enclose my card.

Yours truly, "CHIEF ENGINEER."

To the Editor of the Marine Engineer.

Sir,—In reply to your correspondent, "Ship-owner," as to the benefit derived from compounding simple engines, and as to the relative economy of simple expansive as compared with compound engines. I beg to offer the following remarks:—

The great saving of fuel in modern marine engines over those in use some years back is principally due to the incrased efficiency resulting from the greater rates of expansion of steam which has been rendered practicable by the use of higher boiler pressure, than were generally adopted for condensing engines; the reason of the economy thus derived may be roughly put as follows:—The cost of evaporating any given weight of water into them is nearly the same, whether the pressure is kept at 90 lbs. per square inch or at 30 lbs., which (allowing 15 lbs. for the atmosphere) would be represented by 75 lbs. and 15 lbs. respectively on the pressure gauge. Take two cylinders of equal diameter and same stroke of piston, into one admit steam at 90 lbs. and cut off at ⅙, and into the other steam at 30 lbs., and cut off at ½, it follows that there will be the same weight of steam, the same pressure at half stroke, and the same terminal pressure in both cylinders; but, in the case where steam was admitted at 90 lbs., the mean pressure during the first half of the stroke will be about 63 lbs., whereas in the cylinder having an initial pressure of 30 lbs., the mean for the first half of the stroke will be only 30 lbs., we have thus $\frac{63}{30} = 2\cdot1$, and on the pressure during the latter half of the stroke is alike in both cases, we have $\frac{3\cdot1 \times 1}{2}=1\cdot55$ which is the relative efficiency due to a ratio of expansion of 6 as compared with 2; so that an equal amount of work can be done with about 100 tons of coals, which would require 155 tons with the lower ratio.

In regard to the absolute pressures, it has been ascertained by practice that owing to the unavoidable friction, even in the best constructed engines, there is little or no economy in carrying the expansion below 8 lbs.—that is, 7 lbs. below the atmosphere, which, after deducting 3 lbs. for back pressure, only leaves 5 lbs. per square inch effective on the piston at the end of stroke; therefore the initial pressure, divided by 8, will represent the ratio of expansion required for an economical result.

It would appear that the saving of fuel above referred to ought to obtain equally, whether the steam be expanded in a single cylinder or in two or more cylinders consecutively, as in the compound engine, provided always that the total expansions be the same.

It is found, however, in practice that simple expansive engines do not give so good results as compound, especially where there is a high ratio of expansion. This is, no doubt, accounted for, to some extent, by the greater variation of pressure and temperature of steam during the stroke in the former class, causing very unequal strains on the bearings and excessive friction when the cranks are passing the centres, besides which, any leakage in slide valve or piston of a simple engine causes greater loss as the steam passes direct to the condenser, whereas in the compound engine a similar defect in high pressure cylinder is not so serious, as the steam is intercepted by low pressure slide valve, and so turned to account in large cylinder.

In regard to surface condensers, they were rendered a necessity as soon as high pressure steam was used in boilers of vessels working in salt water, as although there is little difficulty in removing the salt by blowing off at the screw in the usual way, the sulphate of lime cannot be got rid of by that means, because that at the temperature due to steam at 30 lbs. per square inch above the atmosphere the lime is deposited without any concentration, so that the more blown off the more deposit, as more water containing the lime has to be pumped in to make up that blown out; this loss with an ordinary jet condenser working in sea water amounts to about 12 per cent. of the coal burnt, which is, of course, saved by surface condensation; and, further, the boilers being kept cleaner, the fire is brought into better contact with the water to be heated.

As to compounding existing marine engines, if they have common condensers, it means new boilers, cylinders, condensers, and pumps. So there remains bed plate, frames, shafting, connecting rods, piston rods, and valve gear which may be used again if they are in fair order and have sufficient strength and suitable surface to run at a piston speed of, say, 450 feet per minute, and, if supplemented by the necessary new parts, well designed, and a good job, taking care to give plenty of boiler power, there can be no doubt as to securing a great reduction in consumption of fuel in proportion to work done.

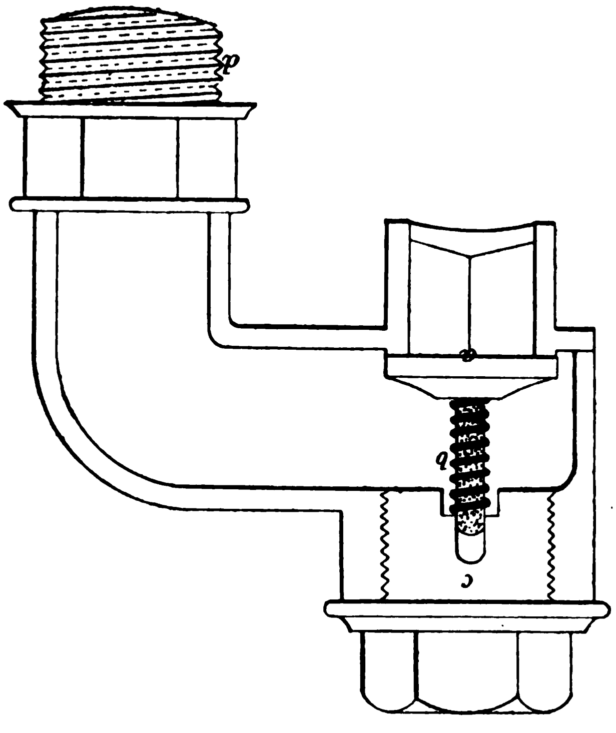
Yours truly, JAMES POLLOCK.

63, Great Tower-street, E.C.

REVERSE VALVES FOR BOILER CONNECTIONS.

To the Editor of the MARINE ENGINEER.

SIR,—I trust you will find space in your valuable columns for a few remarks which I have to make regarding the necessity of having reverse valves fitted on pipes leading from the boiler to the sea. It is well known by the practical engineer that after closing a safety valve, scum cock, or blow off cock, that the hot water and steam left in the pipe between the cock and the sea immediately condenses, causing an instantaneous vacuum, causing the pipe to give a loud report and vibrates, which endangers the flanges being broken at the brazing, which accident came under my notice not long since Such appliances may be in use, but none has ever come under my notice.



I enclose a rough sketch of the valve, which I would advise being adopted:—*a* represents the valve; *b*, spiral spring; *c*, cap with recess for valve, stem, and spring; *d* is the part to be screwed to pipe when it is applied. The spring should be loaded to about ¼ lb. to the square inch. The valve should be placed in a vertical position on the pipe. Trusting that you will find space for the same, I am, Sir, a reader of your valuable journal,

J. K.

Greenock, January 13, 1880.

PRIMING IN MARINE BOILERS,

To the Editor of the MARINE ENGINEER.

DEAR SIR,—In reply to the query contained in your leader last month concerning priming in marine boilers, I beg to offer my opinion that the reason new boilers generally leave off priming after a few weeks' work is because by that time a certain amount of scale is formed on the tubes and plates which prevents the water coming in direct contact with them, thus impairing the efficiency of the heating surface, which will have the same effect as reducing it, and consequently preventing the violent evolution.

Yours truly, W. C. M.

To the Editor of the MARINE ENGINEER.

DEAR SIR,—I perceive in your editorial note on "Priming in Marine Boilers" the following passage: "There is no doubt that if a boiler gives trouble by priming, it might be possibly prevented by the removal of a certain number of the tubes, so as to give greater steam and water space," &c. I oppose any idea to prevent priming by lessening the heating surface, which, I think, does far greater damage than stated in your note. Now, a boiler properly designed will never prime; but the case before us is a boiler which does prime, and, as you say, might possibly be entirely prevented by the removal of one or more tubes. By doing so I maintain you lessen the heating surface to a much more serious extent than you seem to admit in your note; but what does loss of heating surface mean? Simply not enough surface to impart to the water the heat generated by the boiler, subsequently; as the heating surface is too small, so is the waste of heat, or, in other words, fuel, in proportion as great. For instance, the heating surface of one tube only (8 feet long and 2¼ in diameter) is 44,506 square feet. Now if you take that tube away most of that heat finds its way out of the funnel, and the fuel used to generate that heat would be lost, an item not to be treated lightly. What would be, I ask, if two or three were abstracted? Another reason why I absolutely oppose reducing priming by removal of tubes is the loss of weight occasioned one tube 2¼ inches outside diameter, weighs 3,375 lbs. per lineal foot. I will not trespass further on your valuable space, excepting by the addition of the following table:—Grating surface = ·11 to 16 per I.H.P.; heating surface of tubes = 2·3 to 2.5 per I.H.P.; heating surface of furnaces and combustion chambers = ·2 heating surface of tubes; steam space = ·47 to ·54 per cubic feet per I.H.P.; area of funnel = ·11 total area of grates; heating surface of superheater tubes = ·2 per I.H.P. Scum dishes are placed 4 inches below water line. The water line is 9 inches above tubes. One ton of coal occupies abont 44 cubic feet. One pound of saturated steam at atmospheric pressure occupies 32·5 cubic feet. This letter, I think, will be found useful and correct as regards the three distinct classes of marine boilers.

I remain, yours truly, REGINALD ALINGTON.

LONGITUDINAL, OR DEEP FLOOR SYSTEM.

To the Editor of the MARINE ENGINEER.

SIR,—My attention has been called to an article in the *Marine Engineer* on the "Construction of Iron Steamers on Mr. W. Aisbitt's Longitudinal, or Deep Floor System," and I shall be obliged, if you will permit me to give Mr. Aisbitt and your other readers a little information on the same subject.

In the year 1864, ten years before Mr. Aisbitt first thought of the practicability of carrying the ordinary tank girders from the top of the water-ballast tank down to the shell plating, and continuing them fore and aft at far as possible, there were built and launched from the shipbuilding-yard of Messrs. C. and W. Earle, at Hull, then under my management, three vessels named respectively the Sappho, Juno, and Clio, built on tht longitudinal system, now coming so greatly into favour, and which Mr. Aisbitt in his article claims as his own.

I have heard the system called Austin and Hunter's system, by reason, I suppose, of the fact that their having built vessels on this system was made generally known through Mr. Martell's paper on water-ballast tanks, read before the Institution of Naval Architects; but I cannot see any reason why any of these names should be attached to this system, which was designed and carried out ten years before they first thought of it. The vessels I have named above were designed bo the late Mr. Charles Earle, Mr. C. H. Wilson (now M.P. for Hull), the owner of the vessels, and myself; and I submit to you, Sir, and to your readers, that if any name should be attached to the system, it should be that of Mr. Charles Earle, and that "Earle's System of Double Bottom" should be its distinguishing name.

The Sappho is still doing her duty, and can be seen at Hull when in port.

I remain, Sir, yours faithfully, ALEX. GEMMELL.

Official returns lately prepared and issued show that within the past half-year eight vessels of various tonnage and power have been launched, and that at the present moment there are 26 others under construction at the various Government dockyards or by private shipbuilders. The vessels now being fitted or just ready for the pennant include the second two of four double-screw iron gunboats of 264 tons, with engines of 164-horse power, to be armed with one gun each, built at Pembroke, and named the Griper and Tickler; a sailing brig of eight guns and 510 tons burden, named the Pilot, built at Pembroke, a sister ship to the Nautilus; the first three of four composite screw sloops, each of 1,124 tons burden, with engines of 900 horse-power, to carry six guns, named the Kingfisher, Phœnix, and Miranda, the first-named built at Sheerness and the other two at Devonport; a double-screw composite gun vessel of 770 tons and 870-horse power engines, named the Swift, and constructed by the Thames Shipbuilding Company at Blackwall; this vessel, which is 165ft. in length, with a breadth of beam of 29ft., is of very light draught and of a particular rig; and a double screw iron armour-plated turret ship of 8,492 tons, with engines of 6,000 horse-power, to be armed with four heavy guns, constructed at Chatham, and named the Agamemnon. The vessels now in hand, some of which are in a forward state for launching, comprise a double screw steel armour-plated turret ship of 9,150 tons burden, to be supplied with engines of 6,000-horse power, under construction at Portsmouth, and to be named the Colossus; five composite screw gunboats, of 455 tons burden, each to be armed with four guns, and to be fitted with engines of 360-horse power, to be named the Banterer, Grappler, Redwing, Wasp, and Wrangler (the Redwing is being built at Pembroke Dockyard, and is to be fitted for Coastguard service, the other four are under construction by the Barrow Shipbuilding Company at Barrow-in-Furness); three screw composite gun vessels, each of 744 tons, with engines of 750-horse power, to carry three guns each, and to be named the Algerine, Rambler, and Ranger (the first-named is building at Belfast by Messrs. Harland and Wolff, and the other two by Messrs. J. Elder and Co., of Govan, Glasgow); two steel double-screw gunboats of 253 tons each, and engines of 168-horse power, to be armed with only one gun each, and building at Pembroke Dockyard, to be named Bouncer and Insolent; three screw composite gunboats of 455 tons, to carry four guns each, and to be fitted with 360-horse power engines, to be named the Bullfrog, Cockchafer, and Espoir, all under construction at Pembroke; a composite screw sloop of 1,124 tons, to be supplied with engines of 900-horse power, to carry six guns, building at Chatham, and named the Doterel; a double-screw composite gun vessel of 770 tons, and 870-horse power engines, sister ship to the Swift, recently launched, to be named the Linnet, and building by the Thames Shipbuilding Company; a screw corvette of steel and iron cased with wood, of 2,383 tons, to be furnished with engines of 2,300-horse power, designed to carry 14 guns, to be named the Constance, and under construction at Chatham Dockyard; a double-screw steel armour-plated turret ship of 9,150 tons burden, to be fitted with engines of 6,000-horse power, building at Pembroke, and to be named the Majestic; a screw iron armour-plated torpedo ram, with a displacement of 2,640 tons, and to be furnished with engines of 5,500-horse power, building at Chatham Dockyard, and to be named the Polyphemus (when completed this vessel will be different to any other ship in the Royal Navy, being constructed somewhat on the plan of the cigar ship; she is to be provided with a ram of a very formidable description, coming to a sharp point and projecting several feet from her stem; she is being built upon a slip, so that the majority of her plates will have to be put on after she is launched); two steel and iron screw corvettes to be cased in wood, of 2,382 tons burden each, to be fitted with engines of 2,300-horse power, designed to carry 14 guns each, building at Portsmouth, and to be named the Canada and Cordelia; two composite screw sloops, of 1,124 tons, to carry six guns each, and to be furnished with engines of 900-horse power, building at Devonport, and to be named the Espiègle and Mutine; a paddle steam vessel of 540 tons, to carry six guns and to be fitted with 600-horse power engines, to be called the Niger, and building by Messrs. J. Elder and Co., of Govan, Glasgow; a double screw steel armour-plated turret ship of 6,200 tons, to have engines of 4,500-horse power, building at Chatham, to be called the Conqueror. This vessel is to be entirely coated with steel armour, and she will carry only two heavy guns. In the wake of her turret guns and in exposed position her armour will be 12in. in thickness.

THE DUILIO.—It is telegraphed from Rome that the monster ironclad Duilio has just been put into commission. She represents 22,000,000f, and the Italian Navy waits the experiment of her performances for its definitive systematisation. She is now at Spezia. Her displacement is 11,500 tons; nominal horse-power, 7,500. All heavy work aboard, as steering, regulating ventilators, removal of cinders, weighing anchor, is done by steam. There are 33 special engines. She carries four 100-ton guns, worked by special and, in part, newly-invented machinery; also 12 smaller guns and 4 mitrailleuses. A broadside of her four great guns throws 8,000 pounds weight of metal, consumes 2,000 pounds of powder, aud, comprising projectiles, cost 4,000f. At each broadside a force is developed sufficient to raise 48,000 tons to the height of one metre. She is expected to attain a speed of 12½ knots, and doing so will consume 15,000 pounds of coal an hour. She carries a Thorneycroft torpedo boat, 22 metres long, which has attained a speed of 21 knots. She starts on her trial immediately.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from December 19th, 1879, to January 19th, 1880.

Supplied by Fell & Wilding, City Patent Office, 23, Rood Lane, Fenchurch Street, London, E.C.

5192. G. Allibon. Steam generators.
5196. S. Pitt (communicated by H. Brown). Apparatus for ringing alarm bells on floating buoys.
5205. B. Tower. Indicating speed and direction of rotation of shafts.
5208. A W. Pearce, and J. Durie. Grooved pulleys.
5212. A. C. Mather. Valve gear.
5226. C. J. Appleby. Driving, retarding, stopping and supporting revolving shafts.
5227. J. F. Flannery. Steam boiler and other furnaces.
5239. J. H. Johnson (communicated by F. Winters). Valves for steam, gas, and air engines.
5243. L. Perkins. Wearing surfaces of steam and other engines.
5250. D. M. Somerville. Life saving apparatus.
5273. R. Jack. Paddle wheels.
5274. H. J. H. King. Motor governors, and speed and pressure recording apparatus.
5292. H. H. Lake (communicated by Z. Oram and P. B. Grove). Construction of vessels with twin propellers.
5300. A. M. Stewart. "Hurry's" or apparatus for shipping coal, &c.
2309. J. Cassel's (communicated by P. Barclay). Lubricators.
5322. S. W. Snowden. Screw propellers.
5328. E. A. Brydges (communicated by A. E. Muller and J. J. Pollak). Chronmeter movements.
5329. J. and G. W. Newall. Screw propellers.
9. G. T. Pottle. Steam engine governors.
13. W. R. Lake (communicated by D. Parks. (Ships sleeping berths.
14. J. Britten. Bridges.
19. M. Mordmann. Steering apparatus.
20. W. R. Lake (communicated by G. H. Pond and J. .O Bradford). Steam boilers.
59. H. J. Haddan (communicated by C. Parshall). Lubricators.
60. H. J. Haddan (communicatod by C. Parshall). Lubricating machinery.
61. G. W. V. Nawrocki (communicated by B. Grundler.) Regulating transmission of mechanical power.
65. J. D. Larsen. Steam engines.
93. W. A. Gorman. Apparatus for diving and other purposes.
97. J. C. Stevenson and J. B. Price. Steam engines.
100. J. Mackenzie. Boat disengaging gear,
106. J. Blake. Water guages for steam boilers.
110. J. W. Preston (communicated by T. Tripp). Metallic packings for piston rods.
111. J. W. Preston (communicated by T. Tripp). Metallic packings for piston and other rods.
186. R. Thompson. Thrust bearings for screw propeller shafts.
141. J. H. Barry. Apparatus for turning in and out, lowering and disengaging, and carrying inboard ships boats.
144. V. P. Lambert and L. E. Werneau. Application of tides as motive power.
145. W. E. Gedge (communicated by E. St. Pierre). Safety valves for steam boilers.
156. W. Lawson. Pistons.
161. B. Harlow. Boilers and packing rings.
167. J. Dewrance. Steam boiler water guages.
168. L. Perkins and W. W. Harris. Steam engines and boilers.
172. G. L. Scott and S. Hallam. Ventilators.
174. C. O. Ramstedt. Illuminated steam signalling and apparatus.
201. W. B. Thompson. Steam steering gear.
202. W. B. Thompson. Apparatus for signalling at sea.
210. T. Jones. Facilitating generation of steam, in steam boilers
219. J. L. Corbett and W. Lochhead. Propulsion and steering of steam vessels, propellers and mechanism therefor, water wheel motors.
228. J. Wills. Elastic metallic packings for pistons, &c.
230. W. Oliver. Steam packing.
231. F. W. Heinke and G. Lang. Submarine electric lanterns.

Reviews.

Report of the Society of Telegraph Engineers on the Birmingham wire guage.

It may be thought that such a subject as above can have little general interest, and particularly to those interested only in the marine. We can, however, remind our readers, that the use of wire in every description of rigging is largely increasing throughout the naval service and marine. The difficulty experienced in all foreign stations, where brass, iron, or steel, wire, tubes, or plates have to be kept on stock, is to know to what general standard to buy their goods. Birmingham wire guage is an accidental arbitrary standard of measurement. The agitation promoted then by the Telegraph Engineers is to supersede this by a general legalised standard.

Engineer's Annual.—By M'Gregor & Co., of Glasgow, Greenock and Liverpool.

This useful little annual contains in its first pages a calendar and memorandum blank sheets. It is completed by very useful tables of French and other measures, duties, log book of dates and notices with particulars of some of the most famous steam liners. A list of Engineers who have passed their Board of Trade Examinations, is interesting to members of our profession. The concluding yarns are amusing, and a poetic effusion by the late Prof. Rankin, puts his genius in a different and more social light than that to which we are accustomed.

Reed's Engineers' Hand-book.—By W. H. Thorn. Published by Thomas Reed & Co., of Sunderland.

This hand-book contains a great deal of information which is of the utmost value to marine Engineers preparing for their certificates of competency. In the first place the handbook opens by giving all the regulations, fees, days of examination etc. and for obtaining the pass certificates. A very necessary part follows in the shape of exercises in arithmetic and mensuraton in whist, too many practical men are deficient, and for want of which information they dr not obtain all the benefit that arises from practical experiences.

Fully two thirds of the work, however are occupied by the solution of examples of the application of arithmetic, to engineering questions, more particularly to the marine engine. A most useful conclusion to the above volume, is a verbal examination in the use of the barometer, thermometer, and in the management of the engines and boilers. The limits as to how best repair a sudden accident or break-down at sea, are well worth reading and remembering.

The whole book contains a great deal of information at the price.

Transactions of the Institution of Naval Architects.—Edited by the Secretary Mr. Geo. Holmes. Published by Southeran & Co., Piccadilly, London.

This is a most valuable work, containing as it does, papers on those most abstruse subjects, the screw propeller, propulsion, and wave theories, which are resumés of the best brains in the profession, and the result in some cases of many year's labour and observations. One of these papers in a few years' experience of the screw propeller, by A. J. Maggins was awarded the gold medal in the year 1879, for the best paper on screw propulsion.

It is a very interesting, and above all, practical resumé of a large amount of experience and observation. The most valuable facts that Mr. Maggins brings forward most forcibly, are the screws upon the steering of a steam ships when starting, and when at full speed. For those who are scientifically inclined there is a highly elaborate and yet clear exposition of the "minimum" area of a blade in a screw propeller necessaay to form a complete column," by J. H. Cotterill, M.A., F.R.S. The other set of subjects include armour-plating and naval guns.

The structure and trials under steam of the Iris occupy two papers by J. Wright, Esq. and W. H. White, Esq. respectively, which give all the details so necessary to throw light upon the strange experimental results obtained from that vessel. Nor are such details as "the causes of failure in crank shafts;" or, the "oscillometer" forgotten; whilst the paper winds up most appropriately with the memoirs of two late eminent members and ornaments of the profession, viz: John Penn, the successful marine engine builder, and William Froude, the eminently scientific exponent of the abstruse theories of wave translation, resistance of fluids, and screw propulsion. The memoir of this later gentlemen is most interesting in its details showing his opportunities of experiment upon the Great Eastern from his intimacy with Brunel, and referring to many practical deductions in rolling he was able to demonstrate, greatly to the assistance of following generations of naval engineers. The work is completed by a large number of diagrams, illustrative of the different papers, and engraved in the best styles The volume on the whole is one without which no naval engineer or architect's library would be complete.

Notes and Novelties.

A number of improvements have lately been introduced into the fish-torpedo, as manufactured at the Royal Laboratory, Royal Arsenal, Woolwich, for naval service. Hitherto its highest speed has been exercised only at short ranges, not much over 200 yards; but the Admiralty expressed a desire that this speed should be maintained for something like 600 yards, and the mechanical skill of the department being applied to the task, the problem has been satisfactorily solved. The mysterious engines are now made to travel for nearly 800 yards through the water at a *maximum* speed of about 30 miles an hour, and their power of traversing still longer distances has at the same time being materially advanced. It has also been found necessary to strengthen the frames of these marine monsters in consequence of the practice now adopted of projecting them into the sea from the decks of ships, and they are now capable of such endurance that a plunge of 20-ft. after they are set at work and despatched on duty is found to have no detrimental effect whatever upon them. Improved carriages for service with these torpedoes on board Her Majesty's ships are being prepared in large numbers at the Royal Arsenal, Woolwich, and it will no longer be necessary to provide vessels with tubes and other fittings for ejecting the torpedoes, these carriages being of universal adaptation and answering all requisite purposes. All the torpedo carriages in the service are to be converted to the new pattern.

The Nelson, a twin ship to the Northampton (flagship on the North American station), though built and engined by Messrs. Elder & Co., of Glasgow, before being commissioned at Chatham, is ordered round to Portsmouth for the purpose of trying her machinery on the measured mile in Stokes Bay in charge of the officers of the Steam Reserve. She will be tried at full power, two-thirds power, and one third power, and will be brought down to her load line by iron ballast. The trials will be made this month.

According to present arrangements the Iris, Devastation, and Neptune are to be completed for sea at Portsmouth by the end of the financial year, and in order to faciliate the work the refits of the Repulse and the Sultan have been temporily arrested. It is intended to fit each of these ships with electric bells, the same as fitted to the Royal yachts.

The steamers Sarmatian and Prussia, which arrived at Halifaxfrom Nova Scotia, two days before Christmas-day, presented a remarkable appearance on their entry into harbour. The vessels were literally covered with ice. Not only had the hoar frost adhered thickly to every part of the hull and rigging, but every spray from the sea had frozen instantly so that the decks were from 6in. to 12 in. thick in ice, and huge icicles were hanging from the rigging. The vessels had been caught in a frost fog on the Banks on the previous night, and the ice had formed so thick on the rigging and on every part of the ships as to constitute a serious danger to both. The thick fogs which prevail off the coasts of Newfoundland, and which, though they only occasionally extend to the shores of the island itself, being carried thither by south-easterly winds, have given the colony an unmerited character for "fogginess," are caused by the meeting of the warm vapours emanating from the Gulf Stream with the cold air brought by the Arctic current; the currents of hot and cold water and of hot and cold air meet some 200 or 300 miles south-east of Newfoundland, and the warm, moisture-laden air, being suddenly chilled, forms a thick heavy fog. The steamers did not, fortunately, suffer any injury. —*Colonies and India*.

A decree just issued by the Chief of the German Admiralty ordains that the words "port" (backbord) and "starboard" (steuerbord), used as orders to the men at the steering-wheel of a German man-of-war, are in future to be employed in a sense exactly the reverse of that which they have hitherto borne. When the order to "port" is given, or the corresponding signal is made, the wheel is to be turned, or the helm is to be put over, so that the ship's head will turn to port or to the left; and, similarly, when the order is given to "starboard," it is intended that the rudder is to be placed so that the ship's head will be turned to the right. In our own navy, and also in our mercantile marine, the very reverse of the above is, it is almost unnecessary to add, meant by the above-named orders. As the custom on board German merchant vessels is, and will probably continue to be, the same as in English ships, the new order of the Chief of the German Admiralty is likely to prove a fruitful source of confusion and disaster.

Quick Work.—The screw-steamer Hamsteels, belonging to Messrs. Pyman, Bell and Co. entered Messrs. W. Gray and Co.'s graving dock at West Hartlepool, on Wednesday, 17th inst., at mid-day, having her stem carried away and bows completely stove in. The graving dock was dry at 5 o'clock, so that repairs could be proceeded with. Her cables had to be taken out, also her chain-locker. One of her decks had to be removed, 21 shell plates cut off, and the pieces of the stem and frames taken out. A new stem was obtained from Stockton. The whole of the work was done, and the steamer left the graving dock on Monday morning. The steamer lay only three clear days undergoing repair, the work proceeding night and day with the exception of Sunday.

The trade of the Tyne has taken a considerable lift with the advent of the new year. In January, 1879, business people hoped that trade would revive, though the prospects were not bright, and there was a sad lack of confidence in mercantile circles. Until October the business of the year dragged on feebly; the prices of the great staples of the river—coals, iron, and chemicals—were uniformly low and unprofitable. The trade of 1880 has opened healthy and strong, and, so far from merchants lacking confidence in the future, they are eager to enter upon speculative business for deliveries over the year. The coal trade, with the exception of households, is remarkably strong. The gas collieries are well contracted forward at higher prices; merchants and manufacturers are anxious to contract for the purchase of steam and manufacturing coals. In the manufacturing coal trade, upon numerous contracts which have been made, an advance of 1s. per ton, at least, has been established. Steam coal owners hope to realise a stronger advance than that. If they get what the leading offices are holding out for it will be nearer 2s. than 1s. per ton rise, and some collieries hope to get above that figure. If that were reached, with the advances which have been and may be further established in small coals, the colliery owners ought to do very well in 1880. The manufacturing iron trade of the Tyne is very busy. Most of the large concerns are full of work. Several factories are so well supplied with work that they have been obliged to decline orders. The large marine engine works of Newcastle, Gateshead, and Jarrow are very busy. The iron shipbuilding yards have as much work on hand as they can stand to. The only complaint of the shipbuilding yards is on account of a short supply of iron plates. The rolling mills cannot get them out fast enough. Iron steam vessels have advanced in price. In consequence of this, orders for new vessels are not so abundant, and second-class ships have improved in value. But most of the shipbuilding which have as many orders on hand as will keep them fully employed over the first half of the year at least. In the chemical trade most of the factories of the Tyne and Wear are very well supplied with business over January. Merchants are anxious to enter upon trade for February and March shipments and for April, May, and June. Upon the business which has been transacted much higher prices have been secured by the manufacturers than could have been had last year. Some extensive concerns have heavy contracts running, and stocks are short everywhere. There have been large sales of fire bricks and fire clay goods this week. Price of fire bricks, especially best qualities, are advancing. The shipments of sanitary pipes to the Continent are large. From the quantities of this class of goods which are to be exported abroad several of the large cities of the Continent must be engaged in carrying out extensive sanitary improvements. The earthenware trade of the North of England is now in a fairly good condition.

The New Inman Line Steamship.—The largest steamship in the world, save the Great Eastern, which is being built by the Barrow Shipbuilding Company for the Inman Line Atlantic service, is to be named the City of Rome. She will have a total tonnage of 8,300 tons, and her engines will be of 8,500 horse-power. She will be fitted with three funnells and four masts, and it is anticipated she will steam 16 or 17 knots per hour. Her owners intend her not only to be one of the largest and fastest, but the most superbly-fitted steamboat afloat. Special modern arrangements are to be made to promote the comfort of cabin passengers, while in the steerage department an improvement will be effected by the provision of smaller rooms, so that a lesser number of persons will be berthed together. It is proposed to adopt the electric light on the City of Rome, after the success which has attended its introduction on the City of Berlin. The new steamship, the keel of which will be laid in a few days, is to be on her station early in 1881. She will be built of iron.

The Committee on Ordnance, of which Major General Gordon C.B., R.A., is President, having reported to the War Office on the experiments thus far made with the Thunderer 38-ton gun, it has been decided that no further trials are necessary prior to that which is believed will prove the final test, namely, the firing of the gun double-loaded. The programme already carried out serves to show that the bursting of the gun on board the Thunderer could not have been caused by the mere displacement of the shot, nor by any possible mishap with the wad. The negative side of the question having been thus disposed of, the positive proof as to the cause of the bursting remains to be given. According to present arrangements the final ordeal will take place on Tuesday next. Certain alterations and extensions in the construction of the bursting cell facing the proof-butts at the Royal Arsenal, Woolwich, are being carried out by the Royal Engineers, and every care is being taken that the bursting of the gun shall not occasion any peril to the parties present on the ground, or to the neighbourhood. The covered avenue, or gallery, constructed in front of the gun prior to the last two rounds, and doing duty as a splinter trap, has been taken down, and is being rebuilt in stronger fashion, the length being increased to sixty feet. This avenue or gallery will be filled with loose sand, the sides and roof being of massive timbers flanked, covered outside by sand contained in ten thousand bags. The *embouchure* of the bursting cell has also been strengthened and the enire structure presents a very substantial appearance. As void space intervening between the cell and the gallery allows for the lateral and upward dispersion of the powder gas. The sand which will occupy the whole interior of the gallery from end to end, and from the ground to the roof, is intended to arrest the two projectiles and the flying fragments of the gun. The gun itself will be placed three feet farther back than in the former trials, the distance from the muzzle to the outlet of the cell being such that when the foremost charge of powder bursts the coil by which it is surrounded, the effect will be to convert the cell into a species of gun subject to a powerful rending force. As the cell is amply strong for its work, the two charges of powder will simply serve to drive the projectiles and the fragments of iron and steel into the splinter trap, whence they will be ultimately dug out for examination. The contents of the gun, when double-loaded, will consist of 110lb. of pebble powder and an empty Palliser shell, weighing about 700lb. together with 85lb. of pebble powder and an empty common shell, weighing about 590lb. Gas checks and wads will be used, as in the actual gun on board the Thunderer. It is generally believed that if the foremost cartridge fails to ignite either from the flash from the hindmost cartridge, or, from the heat generated by compression, the gun will not burst, though probably the steel tube will be split. Much interest attaches to the forthcoming trial, which, as a deliberate experiment, is unexamplied in its character. The bursting of the gun is the event to be expected, and the effect of so severe an explosion on the bursting cell and the gallery in front of it will be a matter of some note. The arrangements made to arrest the projectiles and the ponderous fragments which will be detached from the gun, also tend to confine the powder.gas, and to increase its disruputive effect on the surrounding structure. The detonating character given to the foremost cartridge by its compression in front of the Palliser projectile, and behind the common shell, is an important element in the affair, tending to exalt the explosive force properly due to the quantity of powder employed.

BOARD OF TRADE EXAMINATION.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Stewart, James ...	2 c	N Shlds	Whitton, A. D. ...	2 c	Lvrpool
Jones, John	2 c	do.	Bunting, George...	2 c	do.
Eason, Thomas ...	2 c	do.	Evans, David W.	2 c	do.
Day, Frederick ...	1 c	do.	Hean, Peter.........	2 c	do.
Dale, Charles C....	2 c	do.	Roberts, Owen ...	2 c	do.
Donaldson, W. P.	1 c	do.	Hunter, William...	1 c	do.
Hedley, George ...	1 c	do.	Douglas, Wm.......	1 c	do.
Spence, M..........	1 c	do.	Lowe, David	1 c	do.
Murrison, J. L. ...	1 c	Abrdeen	Gaul, John W.......	1 c	do.
Kitchin, W. B. ...	1 c	Lvrpool	Livingston, J.......	1 c	do.
Yates, David	1 c	Greenck	Small, Andrew	1 c	Glsgow
Campbell, John ...	1 c	do.	Walker, Wm.	1 c	do.
Geddes, John	2 c	London	Morris, John	2 c	do.
Pool, Joseph	2 c	Bristol	Paterson, Wm. ...	2 c	do.
Wood, Robert......	2 c	do.	Davies, J. C.	2 c	Sndrlnd
Strong, James......	1 c	do.	Clarke, Francis ...	2 c	do.
Young, A. R.	2 c	Glsgow	Wood, J. S..........	2 c	do.
Mutch, John	2 c	do.	Richardson, L. ...	2 c	do.
Murray, A.	2 c	do.	Russell, J.	2 c	do.
Armour, R.	1 c	do.	Watson, E.	1 c	do.
Murdoch, M.	2 c	do.	Dalton, Jas. E. ...	1 c	do.
Hodgson, J. A. ...	2 c	do.	Hughes, T.	1 c	do.
Aitken, James ...	1 c	do.	Weatherilt, N.......	1 c	do.
M'Fadyen, A.......	1 c	do.	Scott, Wm..........	1 c	do.
M'Lachlan, J.......	1 c	do.	Pope, C.	2 c	Lvrpool
Hosking, F. A. ...	2 c	London	Stuart, A. C.	2 c	do.
Nisbet, James......	2 c	do.	Freebody, T. F. ...	1 c	Hull
Pullar, James	1 c	do.	Ethell, Benjn.......	1 c	do.
Fendick, Wm.......	1 c	do.	Johnston, Wm....	2 c	Leith
Chalcraft, Robt....	2 c	N Shlds	Kiddie, David ...	2 c	do.
Park, John	2 c	do.	Baxter, Thos. A.	2 c	London
Thompson, John...	2 c	do.	Hill, Walter	2 c	*do.*
John, David Wm.	2 c	do.	Nelson, Fredk ...	2 c	do.
Hardy, John R. ...	2 c	do.	Morgan, G. L.	1 c	do.
Tose, Robert	2 c	do.	Adam, Geo W....	2 c	Lvrpool
Eskdale, John......	2 c	do.	Bell, Richard	1 c	do.
Forrest, Henry ...	1 c	do.	Flenk, Chas. A. ...	1 c	do.
Thompson, H. W.	1 c	do.	Manning, H. R....	1 c	do.
Littlejohn, Wm. ...	1 c	do.	Darling, Wm.J....	1 c	Grnock.
Crichton, L. S. ...	2 c	Leith	Gemmel, A.	1 c	do.
Laird, Jas. B.	2 c	do.	Wilson, Jno.	2 c	Lvrpool
Pearson, Thos. ...	2 c	London	Ferguson, Jas. ...	2 c	do.
Dobson, Henry ...	2 c	do.	Parry, Evan H. ...	2 c	do.
Adair, Robt.	2 c	do.	Barcham, H. B. ...	1 c	do.
Smeaton, Jas.......	1 c	do.			

ROBERT JACKSON, Registrar-General.

General Register and Record Office of Shipping and Seamen
32, Basinghall Street.

Robert Walker's Patent Hydro-carbon Furnace and Apparatus

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; one ton of Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c.
8.—Cleanliness.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

THE INVENTOR'S RECORD—Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S. (from the reports placed before us of the actual working of the invention) we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with coal.

THE RAILWAY RECORD states "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers.

The MARINE ENGINEER.—For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300, total, 1 400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons, and on the homeward voyage for 450 tons; say together 1 050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4 000 per voyage.

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"Thus in one of our Transatlantic steamers, the space that could be economised when filled with freight, at the present rate, would give us £3 000 (15,000 dols.) over our present receipts. These advantages are immense and must eventually effect a complete revolution in our present mode of steam generation."

For all particulars respecting cost of the Patent Hydro-carbon Furnace and Apparatus and terms of Royalties, application should be made to the patentee, Mr. Robert Walker, C.E., 19 Buckingham-street, Strand, W.C.

NOTICE.

ALL Contributions and Books for Review should be addressed to the EDITOR, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any M.S.S.

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All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 26th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to W. G. Neal, and Crossed Commercial Union Bank, Limited.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER, payable in advance, is Five Shillings per annum.

The Marine Engineer,

LONDON, MARCH 1st, 1880.

EDITORIAL NOTES.

It has been said that facts are stranger than fiction. This has been lately strangely exemplified by the carrying out into practical effect of a sub-marine boat after the very startling description by Jules Verne in his "Twenty thousand leagues under the sea." The author has therein outlined what has generally been considered an impossible conception of a vessel carrying some 20 or 30 individuals which should be able to travel equally as well under water as upon it.

The scientific and mechanical details are well worked out; the atmosphere is carried under water at a pressure and is artificially renewed when required. The lowering or rising of the vessel in the water is effected by the admission or pumping out of the water. All these points have been carried into practical effect by the Rev. G. W. Garret of Manchester. He has built a small vessel 40 feet long and 9 feet beam, of a cigar shape, with a displacement of about 30 tons. In the centre of her upper surface is a conning tower from which the vessel is steered. The engine and propeller it is stated are driven by chemicals, from which also a supply of oxygen is derived to sustain life. The crew consists of three, the engineer, the captain and the owner, who wear helmets into which the oxygen is pumped. She has ventured out on a trip to sea from Liverpool to Portsmouth, but had stopped for a short period at Rhyl to perfect a few matters of some importance to the future comfort of the crew. Should this boat be the success which it so far promises, it will be a most deadly weapon of warfare as a submarine torpedo vessel. It is even difficult now for any ironclad to protect herself against fast sailing torpedo boats, when they attack her openly on the surface of the water. When the attack is made secretly and underneath the surface, we fear that it will be a sorry day for the ironclad, until some new and improved method of defence is introduced against such submarine attack.

Curiously enough, another apparently startling idea, as outlined by Jules Verne in the same volume has we notice been brought lately into practical effect. The author of "Twenty thousand leagues under the sea" has fitted the crew of the submarine vessel with diving apparatus which is represented as independent from any external air supply. This idea is by no means new, as it has been before suggested, but it is only now that the apparatus has been put into practical effect, as may be seen any day at the Polytechnic, Regent Street. A Mr. Fleuss there dons a diving dress and helmet, which enables him to descend into the water, and remain there for some hours, without any connection by air tubes to the surface whatever. The increased efficiency offered by such an apparatus must be obvious to all. The great danger and embarassment to a diver at present is the air tube with which he is supplied by air from the surface. If he should get entangled, or should break the air tube by any chance, his life is at stake. With the new self-contained apparatus, we do not think it a great stretch of the imagination on the part of Julos Verne, to consider it possible for divers or even unskilled sailors, to walk about, at a moderate depth, on the bed of the sea; to go for excursions of miles for the duration of hours entirely unfettered and free to move at will under water. Should this invention accomplish all we have thus indicated, a new and startling era of submarine discovery may begin.

The inter-oceanic canal across the Isthmus of Panama seems to be in a fair way for realization either as labour in vain or as a success. We could have wished, however, that instead of the chimerical tunnels large enough to pass a full-rigged ship through mountains, or, instead of a series of locks and canals ascending a mountain side like a staircase; or even an enormously deep cutting such as is now proposed, the projectors had chosen a route following the natural stream of the San Juan river, through the immense inland sea of Nicaragua. This only requires a short canal or passage through a rocky barrier on the Pacific coast, not exceeding 15 miles in length, nor 100 feet in depth at any place. This would have been mere child's play in the hands of the
ilful and enterprising engineers of the present day.
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agricultural resource. It is a grand scheme to open up direct inter-oceanic communication between two such seas as the Atlantic and Pacific, and we can but wish well and a successful termination to the plucky undertaking of M. Lesseps. There is no doubt that the great and increasing knowledge and use of violent explosives, such as dynamite and nitro-glycerine, will greatly assist modern efforts to open up a chasm through a rocky or mountainous country.

Mr. Plimsoll has been getting into hot water, we see, in the House of Commons. Although Mr. Plimsoll has no doubt done a great deal of good in his time, in drawing attention to neglect of life shewn by many shipowners, in their parsimonius overloading, or the unseaworthy condition of their vessels. At the same time it is well-known that all hard and fast legislation cannot but be very vexatious to the interests of many shipowners, without at the same time having any practical result or object in additional safety to the vessels in question. It is therefore fully justifiable in those members who may have or represent shipping interests, to desire a full and prolonged discussion upon arbitrary legislation, without thereby subjecting themselves to the accusation of "degrading" or otherwise unbecoming conduct. Mr. Plimsoll's published epithets to that effect met with their just condemnation in the House, notwithstanding that their might be due sympathy with Mr. Plimsoll's philanthropic efforts. We think ourselves that much might be done, without repressive legislation, to reduce the risks to all shipping by the greater care in the selection of crew, officers, and engineers. That a better class of men ensures better safety may be seen from the continuous comparative safety with which the better found and better manned lines of vessels carry on their traffic. It is seldom that a vessel of which the captain is part owner comes to grief, from the fact that it is his interest for everything to be well found, and the crew and officers to be the right sort.

We note that a correspondent in our last issue takes exception to our suggestion that the removal of a small tube or two might prevent priming in a boiler. He does not seem to advance that the removal of such a tube might not prevent priming successfully, but that the loss of evaporation thereby will be serious. We think he is mistaken as to the great loss of economy he anticipates from the removal of one or two small tubes, as we make the area of an 8-foot tube, with diameter of 2⅛ inches, to be about four and a half square feet, instead of 44,506, as stated by our correspondent. Nor can we see what the loss of weight by the removal of a tube has got to do with the question. If, as is generally supposed, priming is caused by excessive evaporation in a confined space, it is evident that some evaporation must be given up in order to remove the tendency to prime.

We are pleased to note that some of our readers have forwarded to us valuable replies to the query of a ship owner as to the relative efficiency of compounding marine engines. We would thank Mr. Pollock for his very simple exposition of the principles on which compounded engines, and the higher boiler pressures used therewith, have so materially reduced the consumption of fuel in the mercantile marine and navy. There is no doubt that this has been a much disputed point, not as to whether the economy has been effected, which is self-evident, but as to how much the compounding is to be credited with that economy. We fully endorse Mr. Pollock's views on the subject, and, although we see the "ship-owner" still seeks further practical assurance, we feel sure that a considerable economy would ensue from compounding, on the grounds of more equal stress upon the crank and shaft, and also a smaller range of temperatures in each of the cylinders. We hope some of our practical readers will be able to furnish the practical examples that "Shipowner" asks for.

The great 38-ton gun has at last been done to death. After several successive trials with misplaced wads, which only had the effect of absolutely reducing the wads to tinder, a double charge was placed in her as near as possible to the supposed circumstances of the explosion on the Thunderer. The consequences at the first discharge was the violent rupture of the gun in almost exactly the same way as that on board the Thunderer. This has conclusively proved the investigations and conclusions of the committee to have been correct.

Vice-Admiral M'Clintock reports to the Admiralty that an accident of a serious nature, caused by the explosion due to the faulty breech action of the Nordenfeldt gun, has taken place on board his flagship, the Northampton. Full particulars are anxiously awaited, having been despatched by mail.

BURSTING OF THE THUNDERER GUN.

Tuesday, February 3rd, was signalised at Woolwich by an experiment designed to reproduce the conditions which had been officially reported as causing the disastrous bursting of one of the 38-ton guns in the fore-turret of her Majesty's ship Thunderer on January 2, 1879. The Report of the Committee, which held its sittings at Malta, and was appointed by the joint action of the Admiralty and the War Office, went into the subject at great length, and was generally accepted as a very able and exhaustive statement of the case. The unanimous conviction of the Committee was that the gun which burst had been double-loaded, that is to say, it had been loaded with a "full charge" of powder and a common shell, while it still contained a battering charge and a Palliser projectile. "Assuming the gun to be fired under these circumstances," said the Committee, "the battering charge would be ignited by the tube, and the flame from this, before the expansion of the 'gas-check' fully took place, passing forward, would almost instantly ignite the full charge. At that time, however, the ignition of the battering charge would have driven the Palliser shell forward, and have violently compressed the full charge in front of it, and probably have driven it somewhat forward in the gun." It was shown that this would bring the front charge, consisting of 85 pounds of powder, to a point which, at the moment of the explosion, would be situated about ninety inches from the breech end of the bore, and therefore nearly half way to the muzzle. The Committee went on to say, "An explosion of 85 pounds of powder thus compressed, and having a shell in front of it, occuring in this place would unquestionably be sufficient to burst the gun, the burst extending backward until arrested by the front end of the massive breech piece and C coil' around it." While giving excellent reasons for the conclusion at which they had arrived, the Committee suggested at the close of their Report, "that, in order to restore confidence in guns similar to that which has exploded, the fellow gun should be sent to England, and should then be subjected to a series of tests, and should finally be loaded and fired with a double charge, similar to that which the Committee are convinced burst the left gun of the fore-turret of the Thunderer."

Subsequent to the receipt of a Report from the Malta Committee, the War Office appointed a Committee on Ordance, consisting of distinguished officers of the military and naval services, and to this Committee was referred the subject of the Thunderer gun, with instructions to carry out a series of experiments calculated to show what was the actual cause of the disaster. The experiments conducted by this Committee up to yesterday showed that the bursting of the gun could not have been caused by any possible contingency, supposing it to have been only loaded once. Supposing that the shot had slipped forward out of its place, so as to leave a considerable space between the shot and the powder, it was shown that this so far from endangering the gun, actually reduced the strain of the discharge. Supposing the wad in front of the shot to have been withdrawn by the hydraulic rammer, so as to be struck by the shot when the latter was moving rapidly in the bore, it was proved that this had simply no effect whatever. The only remaining test was that of the double loading, and to that final ordeal the gun was subjected yesterday.

It will be understood that the gun experimented upon was in all respects similar to the one that burst abroad, and was, in fact, its companion in the fore-turret. Its cost may be put down at about £3500. It was formed of a steel tube with four massive coils of wrought iron shrunk upon it, according to the Fraser system of construction. Externally the gun was nineteen feet long, and might be described as divided into three thicknesses, varying from nearly five feet at the breech, to rather less than three feet and a half in the middle, and something under two feet at the muzzle. The diameter of the bore was twelve inches, and its length sixteen feet and a half. It was rifled in nine grooves, firing studded projectiles, the latter having gas-checks. The gun, as prepared yesterday, was mounted on a wrought-iron carriage running on a slide, and occupying a position at the lower end of a long cell about eight feet wide and the same in height, formed in the interior of a built-up mound of earth, measuring nearly sixty feet square at the base, and rather more than twenty feet high. The sides of the cell were supported by massive beams and planks, and at the entrance was some heavy masonry on either side. A space, ranging from three feet on one side to five feet on the other, intervened between the open front of the cell and the "splinter trap" or gallery. This was a structure composed of massive timbers, secured with bolts and angle-irons, and extending for a length of forty-five feet. The avenue, measuring about eight feet in width and height, was filled with sand, amounting to something like three thousand cubic feet. This was intended to arrest the two projectiles with which the gun was to be loaded, as also the flying fragments of the shattered gun. To prevent the carrying away of the splinter-trap itself, the top was strengthened and made heavy with nearly three feet of timber, on the summit of which came six feet of sand-bags. There were also sandbags along the outer side of the structure, and others on the face of the mound over the entrance to the cell, the total number of the bags being about thirteen thousand. The mound and the splinter trap were the work of the Royal Engineers, and were constructed under the superintendence of Captain O'Brien, directed by Colonel Noble, Inspector of Works. The appearance presented by the combined structures was very peculiar. But the event proved that they were admirably adapted for their purpose, both in design and execution.

This experiment being looked upon as the final ordeal, there was a considerable gathering of officials and spectators.

The loading of the gun took place under the direction of Captain Morley, R.A., the proof officer. First was inserted the battering charge of 110 pounds of pebble powder, followed by an empty Palliser shell, weighing, with its gas check, 705 pounds. In front of this came the usual wad. Then the gun received a "full charge," consisting of 85 pounds of pebble powder, followed by an empty common shell, weighing, with its gas check, about 590 pounds, this again having in its front a wad. The total loading of powder and shot thus arranged extended ten feet up the bore, but this was reduced some few inches by powerful ramming, so as to reproduce, as near as might be, the effect of the extra ramming which the double charge is known to have received from the hydraulic machinery on board the Thunderer. All being thus arranged, the company proceeded to take a last look at the doomed gun, after which everybody retired to what was deemed a safe distance. Few, if any, cared to enter the adjacent splinter proof intended as a hiding-place for the Committee, but where nothing could be seen, and the chosen spot was the embankment on the river-side, which was judged to be out of range of any of the lesser fragments which might be scattered by the explosion. The signal bell rang out twice—it might be said that it tolled the knell of the imprisoned gun, which was quietly awaiting the touch of the electric circuit. At five minutes to one a heavy report, deadened by the intervening mass of material, broke upon the ear, and, at the same moment, a cloud of smoke rose from the mound, while some pieces of woodwork flew high in the air, but fell short of the river wall where the spectators stood. The deep clang of the report and the volley of smoke which shot up from a couple of orifices towards the rear of the mound, created a general impression that the *coup de grace* had been given. So eager was the rush from the river-side to the cell, that more than one of the hurrying crowd had an awkward fall over the broken ground, one officer having the ill-fortune to dislocate his knee.

It was soon found that the result was, in one sense, highly satisfactory. The gun was destroyed, and the event was a full confirmation of the Report sent home by the Committee which conducted the inquiry at Malta. In fact, a more remarkable verification of the conclusion arrived at by the Committee could not be conceived, the shattered gun in its cell bearing the closest possible resemblance to the appearance which was presented by the gun which burst in the turret. A front view of the one was almost identical with a front view of the other. The only difference consisted in the circumstance that the middle portion of the gun, consisting of what is called the 1 B coil, was not only shattered by the detonating force of the front cartridge, but had torn away part of the outer coil of the breech, called the C coil, thereby damaging the gun as far back as the trunnions. The coiled breech piece, lying between the C coil and the steel tube, remained intact, projecting some distance beyond the outer coil. The gun carriage had recoiled with some force against the stops, and the violence of the explosion was shown by the torn pieces of the gun which strewed the floor of the cavernous cell. The cell itself was chiefly damaged on the right, and there had evidently been some heavy masses of iron hurled against the roof splintering the thick beams which supported the superincumbent mass of earth. In front there had been a fall of sand bags, and when these were removed further portions of the gun were found. Subsequently, digging operations commenced, and other pieces were disentombed from the splinter-trap. It was impossible, however, to complete the investigation that day, and further time will have to be devoted to the purpose. The pressure gauge placed at the bottom of the bore was duly examined, but failed to give precise information. Previous to its insertion in the gun, it had been crushed with a pressure of 36 tons per square inch. This proved to be excessive, as the copper cylinder was unaltered when taken out of the gun, simply showing, therefore, that it had not suffered a greater pressure than that to which it was originally subjected. Other pressure gauges remain to be recovered.

After the proceedings of mid-day had terminated, the Committee, accompanied by Mr. Bramwell, paid a second visit to the ground, when a very interesting discovery was made. On examining one of the fragments of the steel tube which formed the lining of the gun, Mr. Bramwell detected an abrasion exactly corresponding to that which had been observed in the case of the burst gun abroad. This abrasion was of such a nature as to show that a projectile had passed along the broken portion of the gun after the burst had commenced, thus proving that there must have been two charges of powder in the gun, separated by an intervening projectile. This coincident testimony in respect to the two guns appears to furnish the last link in the chain of evidence, leaving nothing more to be desired. There is, however, one other piece of evidence, which will not fail to command attention. At the request of General Gordon, a careful comparison in the weight of sundry studs was recently made by Mr. Greenhill, a mathematician holding an official position at Woolwich. A stud found in the turret after bursting of the gun on board the Thunderer was considered by the Malta Committee to belong to a Palliser projectile, and not to a common shell. If a Palliser shell were in the gun at the time of the explosion, it becomes certain that the gun was double loaded, as it is perfectly understood that it contained a common shell. Taking a series of studs from the Palliser shells and the common shells fired from the 38-ton gun at Woowich, Mr. Greenhill found that the average weight of the stud from a common shell was 1,282 grains, and from a Palliser shell 1,383 grains. The weight of the stud found in the turret was 1343 grains, and it is computed that the probability of this being a Palliser stud is immeasurably greater than the contrary supposition. It should be further explained that the studs in all cases belonged to the front ring, and, therefore, were properly comparable. It has been considered that the stud found in the turret had been reduced by a small piece being knocked off, thereby somewhat diminishing its weight. The appearance of that part of the stud which was fixed in the shell also favoured the idea that the turret stud belonged to a Palliser projectile, as it differed in its texture from the shank of a stud belonging to a common shell.

Since the above was written the fragments of the 38-ton gun destroyed for experimental purposes in the bursting cell at the Royal Arsenal have all been recovered, and are found to number about one hundred and twenty. They have all been marked, and are being washed and arranged for inspection. The two projectiles were taken from the sand-butt in front of the gun, both broken in pieces, and it is evident from the appearance of the bore that they broke up before leaving the gun, the marks of the rifling being in parts quite effaced. The muzzle-end of the steel tube, about three feet in length, is intact, with part of the wrought iron supercoil remaining attached, and a singular appearance is presented by the rearmost end of this fragment, the steel having being violently rent and incurved, as though a shot or lighter fragment, moving faster than itself, had overtaken it and struck it with considerable force. The crusher gauges fixed in both projectiles have been recovered, but give no posoitive data respecting the pressure produced by the explosion. A very great pressure had been expected, and the copper crushers had consequently been submitted to a pressure of 35 tons to the inch before being inserted in the plugs. This pressure was not exceeded in the explosion, and the only apparent deduction of importance is that a strain which would not be alarming in the power chamber has sufficed to burst the gun at the spot where its thickness and strength suddenly diminish. The Thunderer's two 38-tons guns, which have met with similar fates, were the only two 12-in. guns of their weight in the service, having been supplied on an urgent requisition, before an increase of bore was decided upon. All the 38 tons now in existence have a calibre of 12½ inches and fire special projectiles, whereas the Thunderer's guns always employed the shot prepared for the original Woolwich Infants of 35 tons.

CONSTRUCTION OF STEAM VESSELS.

At the Royal United Service Institution last month, Major Moody, who was for many years a commander in the Eastern passenger trades, described an invention of his to remedy what he considers radical defects in the construction or model of steam ships—viz., excessive length, excessive draught of water, and insufficient beam. The extreme length of ships resulted, he said, in a corresponding degree of weakness. Of this there was sufficient evidence in the almost daily records of the breaking of shafts, in the case of long, narrow ships; many of which ships are known to be, in other structural respects, of a superior class. Their great length allowed them to bend and buckle about so much in bad weather and cross seas that a tremendous strain is brought to bear upon the shaft, that being the only thing which cannot bend. There is no doubt that many vessels have foundered with all hands from this cause alone. About a year ago the steamship City of Brussels, of the Inman line, broke her shaft on a voyage from New York to Liverpool. Although she had more sailing power than the steamships of any other line, she was thirty-eight days getting to port, and was given up for lost. The anxiety caused at the time was naturally great, as she had on board 300 passengers and a crew of 120. Major Moody said he could name a dozen other steam vessels which, within the last twelve months, have all been similarly disabled, and have just managed to reach port. Major Moody claims that by his invention of a double rudder and moveable propeller steamers would be vastly superior as passenger ships, inasmuch as the vibration, rolling, listing, and other discomforts which are now experienced in trans-Atlantic and similar voyages would be reduced to a minimum, and the greatest possible comfort secured. Major Moody is convinced, judging from his own experience, that no steam ship should be longer than seven times the length of her beam. The broadest part ought to be a little before the midships and narrowed in towards the ends. The extreme beam ought to be carried up to the deck or gunwale, which would prevent the vessel from rolling and listing over under sail. But the flat bottom and no keel is the great cause of steamers rolling so heavily, and to prevent this all steamers should have a deep keel or, which would be better, a great rise of floor. No part of the lines of a ship should be flat, square, or hollow. Major Moody added:—"It is necessary, in order to have an easy as well as a safe ship at sea, that her sides should form an approximation of the segment of a semicircle, in which case she would only fall into the seas gently, but the seas striking her would not have such a damaging effect upon her round sides as they have upon the flat-sided ships. Seamen of 20 or 30 years' experience will remember the good old East Indiamen, or the fine old round-sided frigates that went to sea for years and never lost a boat, bulwark, or man, and would never capsize in a gale of wind or squall. But now the modern ship or steamer scarcely gets through a gale of wind without doing some damage and hurting or losing a seaman or two. In fact, the finest merchant steamships in the world are constructed at the present day to go under water and not over it, and for this purpose they are covered with iron 60 or 70 feet at the ends."

THE engineer's report to the Directors of the North-Eastern Railway states that the works at the Hartlepool Docks are so far completed that the testing of the hydraulic machinery and the dock gates is being proceeded with; to complete the testing may take a fortnight or three weeks, and when this has been done the water will be let into the docks. There will then remain the removal of the cofferdams, and the dredging of the earthwork left in to support them, which may require two or three months more before the docks will be ready to receive vessels.

THE GUNS OF THE FUTURE.

A discussion took place at the Royal Artillery Institution, Woolwich, Wednesday, Feb. 4th, on the gunnery question, and was of special interest and importance at the present juncture. It arose upon a lecture dealing with the recent experiments at Meppen, the lecturer being CAPT. ORDE BROWNE, late Royal Artillery, who contended that Krupp's 71-ton gun was a much better weapon than the British 80-ton gun, as it fires a heavier projectile with a higher velocity, producing 1½in. more penetration, with less pressure on the bore, the only reason being that it is a better proportioned gun. Its main advantage being its greater length, he argued that breechloading had become imperative, because the labour and inconvenience of muzzleloading increase with the length of the gun, and ultimately become almost impossible.

General Sir John Adye, R.A., late Director of Artillery, and now Governor of the Royal Military Academy, remarked that the 80-ton gun was designed six years ago, and it was only to be expected that the progress of science would produce better results in ordnance of later date, and some of our own muzzleloaders of smaller calibre had already beaten the corresponding breechloaders of Germany. His own opinion, supported by that of Captain Andrew Noble, of Sir William Armstrong's firm, was that there was no difficulty in making guns, whether breechloaders or muzzleloaders, which, being of the same calibre, shall produce identical results in range, accuracy, velocity, and power. Other considerations, though important, were not vital. Which, for instance, is the more convenient and the more rapid, the simplest, the cheapest, and the safest? He doubted the assertion of Captain Orde Browne that great length was fatal to muzzleloading, for the 38-ton gun, which was 19ft. long, was fired five years ago in a contracted casemate at Shoeburyness, loading by hand, and fired for two days at the rate of one round in two minutes. He doubted whether so prolonged and crucial a test had been applied to any breechloader of the same size. He feared that breechloaders in turrets, having to be frequently opened, might half suffocate the crew, and that the necessity of great care in opening and closing the breech in a dark and confined space might cause confusion, delay, and accident. He instanced the bursting of a large Krupp gun on board the German training ship, killing and wounding all the gunners save one, and said this was by no means a solitary case. The German 9-pounders used in the war with France in 1870-71, fired only the small charge of 1lb. 1oz., and yet large numbers of them failed on service, the German official reports showing that 210 became disabled, chiefly from the weak breech mechanism. Their siege guns were also so uncertain that out of seventy of them before Paris thirty-six became unserviceable in fifteen days. Colonel Maitland reported that two Krupp field guns out of five in one battery became disabled by the enemy's fire in the Russo-Turkish war. Herr Krupp had stated in 1878 that the whole of the German breechloading siege and field artillery had been remodelled, which was a confession of weakness, and the test of war had not yet been applied to establish the improvement. In concluding a lengthy address, Sir John Adye admitted the desirability of extended experiments, and stated that the breechloaders now in course of manufacture at Woolwich would afford the means of ascertaining much that was doubtful on the subject.

General Gordon, C.B., R.A., expressed a conviction that breechloading ordnance was a necessity forced upon the nation, as muzzleloaders could not be further lengthened, and had consequently reached their extreme power. Breechloading enabled Krupp to make his gun twenty-two times as long as the bore's diameter, while England's 38-ton gun was only eighteen diameters, and the 80-ton gun was about the same. The power of the Krupp gun was undoubtedly greater than that of the 80-ton gun at present, but if they would put on a few more feet at the muzzle, he was satisfied that the comparison would be reversed. But in order to load a longer gun they must have a breech arrangement, and it need not be a weak one. The gun which burst on board the German training ship was an old one, and it did not give way at the breech. There had been good reasons for hesitating before making such a costly alteration in the national armament, but the change was inevitable, and could not come too soon.

Admiral Boyes, who was asked to represent the views of the Royal Navy on the question, said there was a general desire for a full and careful series of experiments, and the Admiralty and War Office were fully in accord in desiring the most complete efficiency. No one would prefer breechloading to muzzleloading without good reasons, and the thorough change of stores which would follow the adoption of a new system was strongly against it. He cited some facts to show that the present guns were accurate and sufficiently rapid in action, and showed that the gunners were better protected now than they would be if they had breechloaders on board ships; but nevertheless he admitted that recent researches favoured a change of system. The improvements in gunpowder, and the conditions in firing it, pointed to the increased length of the gun as a necessity, and a ship could not carry long guns unless they were breechloaders.

Admiral Hamilton, Surveyor of Naval Ordnance, supported the remarks of Admiral Boyes.

Major Sladen, R.A., Professor of Artillery, Royal Military Academy, thought that breech-loading guns would be always more dangerous than muzzleloaders, but that they would be more accurate, as better adapted for centreing the shot, and as they were in the direction of progress the risk would probably have to be accepted.

Major Stoney, R.A., Instructor at the Artillery Institution, deprecated a hasty acceptance of the German model, and especially objected to the introduction at present of steel guns.

General W. J. Smythe, RA., F.R.S., who presided, expressed the thanks of the meeting to Captain Orde Browne for his paper, which had led to so interesting a discussion. The question was a very important one, and it ought to be thoroughly investigated in order to satisfy public opinion, and bring about the result which every one desired in promoting the thorough efficiency of the national armaments.

The proceedings then terminated.

PROPOSED NEW CHANNEL FERRY BOAT.

At the time when the engineering, mercantile, and travelling minds of the country are directed to the feasibility of travelling the English Channel, or devising other means by which the transit of people and goods between England and the Continent can be facilitated, and the dreadful sufferings of *mal de mer* minimised or avoided altogether, comes forward a proposal to meet the case by building a huge ferry-boat, which from its size and construction will take in trains of goods and passengers, and so resist the ever-prevailing waves of the Channel passage, and render a trip across the silvery streak as pleasant and free from inconvenience as any inland journey. The new idea, we believe, emanated from the fertile brain of an influential Scotchman, who proposed to construct a new line of railway to Beechy Head, to correspond with the new direct line from Dieppe to Paris, and to connect the two direct land railways between England and the French capital with a floating railway station and railways. By this *route* the journey to Paris will be shortened by one hundred miles, while floating platforms to connect the ferry with the shore rails will allow of embarking and loading at all states of the tide, and enable the ferry, therefore, to make two trips each way every day. The magnificent conception was first intimated to the public in the summer, when the promotor of the scheme advertised for a competent naval draughtsman to prepare plans and sections, and to make a model of a ferry-boat suitable for the purposes above described. Among those who answered the advertisement was Mr. Robert Zimmermann, draughtsman at the Palmer Shipbuilding and Iron Company (Limited), Jarrow, who, in due course of time, was entrusted with the important commission. During the intervening months that gentleman has been engaged developing the important undertaking, and on Saturday afternoon the result was made known, when Mr. Zimmermann invited a few friends to inspect the outcome of his ingenious labours. The model of a proposed monster "floating railway station" was on view in the model-room of Messrs. Palmer's yard, Jarrow, and not only for the handsome character of the workmanship, but for the intimate knowledge of the scientific difficulties to be surmounted, and the skill with which they had been met, Mr. Zimmermann's handiwork was deservedly admired. The ferry-boat designed by the artist at first glance presents a rather curious appearance to the eye of persons accustomed to look upon the tall and stately navies afloat around our [illegible] The general outline of the hull of the monster is shaped like the body of a sole—a sharp stem being in the place of the head. The structure measures 650 feet in length by 150 feet in width; with a total depth of 36 feet, being as long and twice the width of the Great Eastern. The hull is divided into three sections, namely, first there is a double bottom 7 feet in height, over which is the main hold, having a height of 19 feet, and rising over all is a deck house 10 feet in height. The double bottom is parabolic in form, is designed to be constructed of half-inch steel plates, and divided into over 200 water-tight compartments, all strongly bound together by an internal frame-work of stays and girders. The hold is covered with what is known in marine circles as a "turtle back," so as to throw off and counteract the action of the waves in heavy weather. In the hold there is provided ample space for the stowage of no less than 180 loaded railway trucks or railway carriages of the usual size. The reception and disposition of this immense number of carriages—or, as it may more appropriately be described, of several railway trains at once—are very simply, yet ingeniously arranged for. At the fore-end of the hold, a large hatchway is placed on a level with the land rails, and on the flooring of the hatchway are two sets of rails, to which the carriages or trucks are run into the hold, on the floor of which are laid down no less than eleven sets of rails, whence the various trucks, &c., are shunted, and so the weight is distributed equally over the whole of the boat. As it is not expected that persons travelling will care about sitting in the carriages during their stay in this "large railway station" while being floated across the Channel, a numerous suite of saloons, waiting-rooms, &c., are provided for their better comfort and convenience in the deck house above the hold. This structure—which is erected upon the top of the turtle back of the vessel, measures 500 feet long by 58 broad, and will provide accommodation for 2,000 passengers. It will be seen from these figures that the deck house is 150 feet shorter and 92 narrower than the extreme measurements of the ship, by which arrangement it is calculated that ample provision has been made for the protection of the deck house even in the stormiest weather. This fact will perhaps be made more apparent by stating that from the water line, which is protected by a strong fender of oak timber 18in. by 12in. to the base of the deck house, there is a vertical height of 19 feet, with a sloping surface 45 feet in length along both sides of the ship, while at the ends the sloping surface is about 80 feet in length. The engine power to propel this immense structure and heavy cargo is designed for the after part, where, protected by the hull, will be worked four large paddle wheels, each of 30 feet diameter; and two auxiliary screws to be be used in assisting to steer, as well as in supplementing propulsion. The body of the vessel at the after-end separates into two tunnels, and in each of these tunnels two of the paddle wheels are placed. By this arrangement—as in the case of the Channel steamer Calais-Douvre, built in 1878 by Messrs. Leslie and Co., of Hebburn—the paddles will be protected from violent contact with the waves in stormy weather. The speed to be obtained is estimated at 14 knots, or 16 miles, per hour—for which engines equal to 12,000 h. p. indicated will be provided. This speed will enable the voyage between Beechy Head to Dieppe, a distance of some 60 miles, to be accomplished in four hours. The steering apparatus consists of three rudders connected with steam-steering gear. In connection with this most important part of the design for the novel ship, the same regard for perfect security and skilful provision against mishap from accident, and the many exigencies of a Channel passage, has been shown by Mr. Zimmermann. In order to ensure simultaneous action in the rudders, they are connected together by means of two distinct sets of gearing, so that if one fails the other can immediately be put into use; and then again, should the rudders themselves be carried away, the vessel can be steered by means of the auxiliary screws. In connection with the engine department it may be observed that, instead of providing the usual "bunker space" for the coals to be consumed during the passage, another simple but novel plan has been adopted for the two-fold reason of economising time in loading and to facilitate work in the engine-room. Instead, therefore, of taking in the "bunker coal" in the ordinary way, it is intended that the coals shall remain in the trucks in which they leave the colliery yard, and so run on board on to a line of rails at the extreme side of the hold, and so round to the engine-room, where each truck or waggon will be emptied as required, and passed round to the other side of the hold ready for discharging at the end of the journey. By this handy method ample coal supplies will be kept up, and no more time will be consumed in taking in the "bunkers" than is necessary to draw out the empty set of waggons and running in the full ones. Such is the monster "floating railway station" by which it is intended to bridge over the English Channel, and to render the railway connection between the English and French shores as complete as that between the Scotch and English capitals. The scheme is one of great magnitude, and is fraught with importance to the commercial prosperity of the empire, as well as contributing to the comfort and pleasure of the many thousands who yearly visit the Continental cities and health resorts in pursuit of pleasure and health. As mentioned above, the idea belongs to a Scotch gentleman now residing in London, and who is forming a company in order to give it "a local habitation and a name." It only remains to be stated at present that the model, which has been on view at Messrs. Palmer's yard, Jarrow, is a beautiful specimen of naval architecture, not only exhibiting that highly-finished workmanship for which Tyneside artizans are so justly celebrated, but likewise the ingenuity, fertility of invention, and mastery over the various and intricate difficulties to be met with in combatting the stormy elements of the ocean. Mr. Zimmermann's model measures 10ft. 3in. long by 2ft. 4in. wide. The model was on Friday tested on the river for its stabllity in the water, and, though there was a good swell on, the tiny craft showed only a very gentle movement, the waves running along the sloping sides of the turtle back in graceful curves, and so testifying to the correctness of the artist's design. It may be further added that among the professional gentlemen who have inspected the model the general opinion prevails that Mr. Zimmermann has successfully solved the problem given him, and that the idea is capable of a much wider application than merely the Channel traffic. For instance, by the recent calamity in Scotland no little doubt has been engendered in the public mind as to the stability of such huge bridges, while the immense cost of such structures is a material drawback to their erection. By means of the "floating railway station" no breaking up of the train is required in transhipment from one shore to the other, hence the Forth and the Tay can be as effectually "bridged" by such means as by the costly and dangerous iron roads designed by civil engineers. The model, after remaining on view for two or three days, has been forwarded to London for the purpose of being thoroughly tested by the Admiralty officials as to its floating capacities, stability, &c.—*Newcastle Daily Chronicle.*

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

PRIMING IN MARINE BOILERS.

To the Editor of the MARINE ENGINEER.

SIR,—This subject has of late been ventilated in the Correspondence Columns of your journal to very little purpose. Judging from my own experience and observation on the subject, I consider your editorial remarks in the February number to the point, more especially what you say regarding the use of tallow and the removal of superfluous tubes. It is a fact well known that tallow and other kindred substances introduced into marine boilers having Surface Condensing Compound Engines, have an injurious effect, caused by the fatty acids generated from the decomposition of the tallow intensified by temperature and pressure; so therefore should never be resorted to in any attempt to prevent priming. In your remarks about the removal of superfluous tubes, you are perfectly correct, as in many cases that is a first class remedy without the slightest increase in coal consumption, and a considerable increase in the steaming properties of the boilers, although, had the tubes been left out originally, the results would have been much better by having the combustion chambers lowered. Your correspondent signed R. Allington in the January issue gives your readers a novel method of curing priming. If I understand his drawing and description properly, the inch pipe he mentions is in no way connected with the main steam pipe, but only runs across the steam outlet, as marked by the thick line shewn in sketch. How this can prevent priming I fail to see, but if my supposition about the drawing is correct, Mr. Allington has certainly a tangible reason for rushing into print, and finishing up his letter with the startling information contained in the last four lines.

In your February number, another correspondent signing himself Reginald Allington (probably the writer of the former article) attacks your editorial remarks in the January issue on the removal of some tubes. I am afraid this correspondent is completely at sea when writing about marine boilers, judging from what he says when speaking of tubes 8ft. long by 2¼ in. drain, having 4 4506 square feet of heating surface. What would be (he asks) if two or three such tubes were abstracted, I answer this by saying that the colorific value of such tubes, is of so little importance, that in a boiler sufficient for 500 indicated horse-power, a dozen or two could be removed without injury. Where did your correspondent design marine boilers with 2⅛ tubes 8ft long, having 4.4506 square feet of heating surface? He goes on to say, scum dishes are placed 4 inches below the water line. One ton of coal occupies 44 cubic feet, and one pound of saturated steam at atmospheric pressure occupies 32.5 cubic feet. May I ask him what those things have to do with priming?

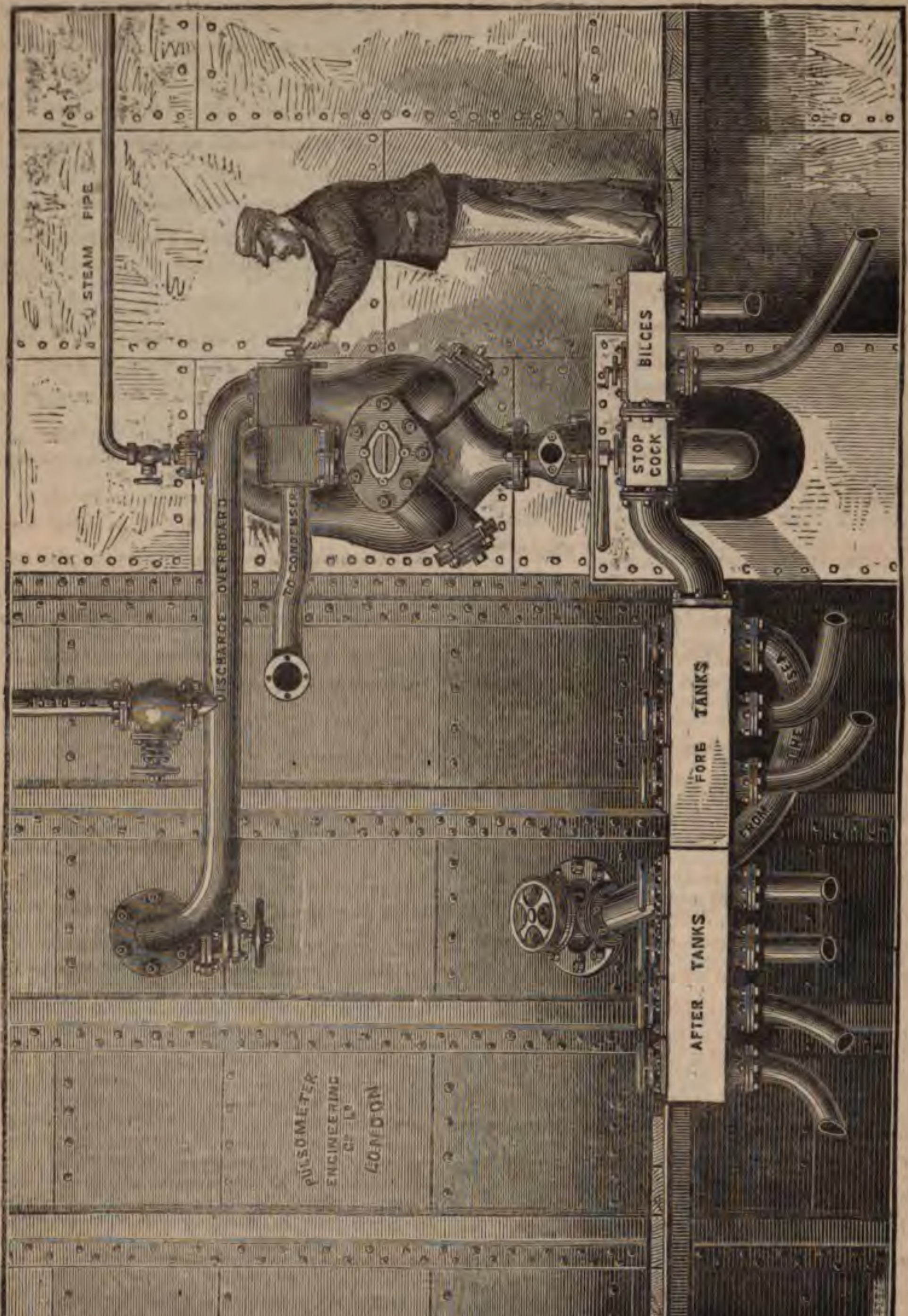
Before long Mr. Reginald Allington may learn more about marine engines and boilers, and be in a position to give your readers something theoretical or practical, and show himself acquainted with the subject he takes in hand, displaying a nobilty of mind above a novice or schoolboy.

Yours truly, "CHIEF ENGINEER."

Glasgow, February 21st 1880.

P.S.—I see a letter signed "Chief Engineer" in your February number, on "Improvements for Saving Fuel in Steam Ships" I beg to draw your correspondents attention to the December number of your journal, where he will see a letter signed by another "Chief Engineer."

MESSRS. HENRY HUGHES & SONS' COMPLETE SALINOMETER.—We have had our attention drawn to a very compact and useful "Complete Salinometer," manufactured and sold by Messrs. Henry Hughes & Son, of 59, Fenchurch Street, London, E.C. It consists of a suitably-shaped copper pot, having a long wooden handle, to prevent scalding when being used, and in which the whole of the instruments may be safely packed when not in use. There is a gilt metal salinometer, a glass ditto, and a thermometer; the stems of the Salinometers are marked, in the usual manner, from 0; the density of fresh water, at a temperature of 200° Fahrenheit, up to 4 | 32, or four times the average weight of sea water over fresh water, each of these four divisions being sub-divided into quarters. At 2½ | 32, the word "Blow" is engraved, and at 3 | 32 the word "Limit," all these divisions being correct at the same temperature of 200°. They appear to be well and accurately constructed. Since ordinary jet condensers have been superseded for marine purposes, there has been, in many instances, a laxness in using the salinometer, for which there is no excuse; and very often, through gross carelessness, the boilers are allowed to work with the water at a greater density than they ought. Frequently large quantities of steam are used in driving ballast and donkey pumps, steam-steering gear, and other purposes, and the engineer contrives to make up the lost quantity of water without thinking of using the salinometer, or a little is blown out by guess-work. Only recently an instance came under our notice. Two old boilers were removed from a ship; on being cut up they were found to have several inches of salt and scale on the inaccessible parts. Enquiry was made aboard the ship for the salinometer, and, after some delay, it was ultimately produced, but in such a state that it had evidently not been used for some time; in fact, it told its own tale.


STEAM PIPE
BILGES
STOP COCK
DISCHARGE OVERBOARD
TO CONDENSER
FORE TANKS
AFTER TANKS
FROM THE SEA
PULSOMETER ENGINEERING Co Ld LONDON

THE PULSOMETER FOR MARINE PURPOSES.

THE PULSOMETER FOR MARINE PURPOSES.

We have lately drawn attention to the great advantages resulting from the use of independent pumps in all steamers which may be applicable to a large series of different purposes, such as circulators for the condenser, to empty the ballast tanks or bilge, to keep under a leak, and to supply water for fire or deck washing. The advantages to the working of an engine by having its condenser supplied with water from an independent source, other than the engine pump, we have already enumerated. The supply of water may be regulated to suit the climate, or the indications of the vacuum guage. The water can be put in circulation before the engines start, and a preliminary vacuum thus formed by a steam jet. At the same time the whole of this powerful pumping power may be applied to keeping down a leak, or to clearing out the bilges, without interfering in any way with the continued action of the condenser.

The accompanying illustration shows the Pulsometer as fitted by the Pulsometer Engineering Co., of Queen Victoria Street, E.C., to a steamer, for these combined purposes. The construction of this pump is one of the modern marvels of ingenuity and simplicity. There are no working pistons, the water being drawn alternately by condensation, and then ejected by direct elastic pressure. The working chambers are two in number, united in a common neck at the top, and in a common suction pipe at the bottom. The steam is admitted direct from the boiler to the top of the pump, where it meets a ball valve, oscillating between two alternative seatings, one over each chamber. The steam enters whichever chamber is not closed by the ball valve, and quietly depresses or ejects the water, which is always standing there after the pump has been once primed. When the steam has driven the water down to the exit at the bottom of the chamber, it mixes with the water and becomes rapidly condensed, thereby dragging over the ball valve, and closing the steam entrance. A vacuum is thus formed in the one chamber, whilst the ejecting action of the steam is diverted to the other chamber, and so on "ad infinitum."

These alternate ejectments and vacuums are formed so rapidly, that the steam valve is continually oscillating from side to side, thus producing as it were pulsations, giving rise to the term "Pulsometer."

The valves used by this pump are two suction and two delivery valves at the bottom of the two working chambers, and one steam valve at the top. The pump valves are made of a rubber disc upon a solid gun-metal grating, with the usual guard. They are thus perfectly noiseless, and will wear a great length of time. When worn out, the rubbers are easily replaced at a low cost. Containing no wearing parts except the ample valves, the Pulsometer may be relied upon to be always in repair and ready for use. There is also a great saving of time to the engine-men, as there are no glands to pack, or lubrication to attend to.

A great advantage in these pumps, as applicable to bilge purposes, is the fact that from the absence of a working piston, any chips, grit, coal or dirt, will pass freely through the pump.

The cheapness of apparatus, both in first cost, in fixing as no exhaust pipe is wanted, and in after repairs, is well worth the attention of ship-owners in these hard times, even without further advantages.

In case of all the stop cocks being accidentally shut, no pipes can be injured or burst, as the pressure is perfectly elastic, and for the same reason the even steady pressure prevents injury to the leather hose, for fire or deck washing purposes. It seems also from many testimonials that the Pulsometer is more economical in the use of steam than ordinary donkey-pumps.

Ship-owners and underwriters should open their eyes to the great advantage to safety, for steamers to be fitted with as many such independent pumps as possible supplied by donkey-boilers on an upper deck, so that even if the engine fires are swamped, these pumps which will pump very well under water, would be able to clear the engine room. We see from a long list of thirty seven steamers among others supplied with Pulsometers from the Orient downwards, that these Pulsometers are obtaining substantial support from discriminating ship-owners.

IMPROVED RUDDER.—An important order has been received at Portsmouth with respect to the construction of the two steel corvettes, Canada and Cordelia. A distinctive feature in their design is the addition of an auxiliary rudder, which it was intended to place under the screw shaft in the after deadwood or run, and which it was thought would be of service in the event of the main or stern rudder, which is unprotected, being shot away or injured. It would seem that the auxiliary rudder has not yet given complete satisfaction in the ships of the *Comus* class which have been tried at sea, and it has been determined to introduce an important modification in the two ships building at Portsmouth. Instead of the auxiliary rudder being fitted at the stern, it will now be fitted under the forward dead run, where a box is constructed into which it will be lifted when not wanted. It will be worked through the keel by means of manual gearing well under the water-line, and in design closely resembles the bow rudder with which Messrs. Yarrow have provided their recent torpedo boats. The new rudder is upon the balanced principle. The progress which is being made with the new corvettes is not great, but it is expected that their advance will be fully up to programme by the end of March.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial ships, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES (ENGLISH.)

Hercules.—On the 26th January Mr. George Brown, Wilmington, Hull, launched a steam yacht for Mr. J. Palmer, of Lincoln. She was named Hercules by Miss Ada J. Brown.

Mary Anning.—On the 27th January the Palmer's Shipbuilding and Iron Company (Limited) launched from their yard at Jarrow-on-Tyne a new steamer of the following dimensions:—Length over all, 250 feet; beam, 30 feet 9 inches; depth of hold, 20 feet. She is classed 100 A 1 at Lloyds, and both ship and engines have been built under special survey. The vessel is fitted with the most modern appliances for economy and despatch. On leaving the ways the ceremony of christening was performed by Miss Crossley, of South Shields, who named the new steamer Mary Anning. She will be commanded by Captain Evan Thomas, late of the steamship Henry Anning, and will be employed in the American, Black Sea, and general trades.

Thomas Owen.—On the 28th January there was launched at Borth, near Portmadoc, by Mr. John Williams, of Portmadoc, the schooner Thomas Owen. Length, 65 feet; breadth, 21 feet; depth of hold, 10 feet 9 inches; registered tonnage, 87.

Silver Dart.—On the 28th January a fishing-boat, called the Silver Dart, was launched from the building-yard of Messrs. Hastings Brothers, at Yarmouth. She belongs to Mr. W. Thrower, of Admiralty-road, and is built on the Penzance principle, being the first vessel of that description built at Yarmouth.

Lemnos.—On the 31st January Messrs. Short Brothers launched from their shipbuilding yard, at Pallion, Sunderland, a screw-steamer for Messrs. Lumsden, Byers, and Co., of Sunderland, of the following dimensions, &c.:—Length, 260 feet; breadth, 34 feet; and 18 feet 6 inches depth of hold; classed 100 A Lloyd's Registry, to carry about 2,150 tons dead weight on a light draught. She has iron decks, four steam winches, and all the latest improvements, and is to be fitted with engines of 140-horse power, by Mr. George Clark, of Southwick Engine Works. On leaving the ways the vessel was named the Lemnos by Miss Nicholson, daughter of the Managing Owner. She will be commanded by Captain Clarkson, and is intended principally for the Black Sea Trade.

Bewayo.—On the 9th February Messrs. W. H. Potter and Son, Shipbuilders, launched from their yard at the Queen's Dock, a steamer of about 1,600 tons, built to the order of Mr. Joseph Hoult. As the ship left the ways she was christened the Bewayo by Miss Lloyd, daughter of the Rev. T. R. Lloyd. The Bewayo is the first of four steamers Messrs. Potter have on hand for the same Owners. She will be fitted with machinery and boilers by Messrs. John Jones and Sons, and is intended for the Owners' Spanish and Demerara trades.

Utrecht.—On the 11th February Messrs. Raylton Dixon and Co. launched from their Cleveland Dockyard, Middlesbrough, an iron screw steamer of 2,250 tons gross register, and 220-horse power nominal, for the Rotterdam Lloyd's Mail Line between Holland and Java. The dimensions of the vessel are:—Length, 315 feet; breadth, 36½ feet; depth, 27 feet. She is classed 100 A 1 at Lloyds, and will be fitted with cabin accommodation for first-class passengers in large deck-house, specially arranged for good ventilation, and containing large saloon panelled in polished marble. On leaving the ways she was christened the Utrecht by Mrs. S. A. Sadler, and is a sister-ship to the Gelderland, built by the same firm some short time ago.

Beryl.—On February 11th there was launched from the iron shipbuilding-yard of Messrs. M. Pearse and Co., Stockton, an iron screw steamer of the following dimensions, viz.:—Length per registered dimensions, 240 feet; extreme breadth, 32 feet; depth of hold to top of ceiling, 16 feet 6 inches. This vessel is about 1,360 tons O.M., is classed 100 A 1 at Lloyd's, and has been built under special survey. She has a long full poop extending 30 feet forward of the midship frame. Her main deck, fore and aft is iron, and has double bottom for water ballast. She has top-gallant forecastle, is schooner-rigged, with double topsails on the foremast. She is furnished with four double-cylinder steam winches, and replete with all the latest and most approved appliances for loading and discharging cargoes expeditiously. The engines for this vessel, which are on the compound direct-acting principle, with double-ended boiler, are of 110-horse power, and from the establishment of Messrs. Blair and Co., of Stockton-on-Tees. This steamer is built for a Hull firm, and is the second vessel Messrs. Pearse and Co. have built for the same Owners. She is intended for the Mediterranean trade, and as she left the ways received the name of Beryl.

Lismore.—On February 10th, there was launched from the shipbuilding-yard of Messrs. Gourlay Brothers & Company, a finely modelled screw steamer which has been built to the order of Messrs. G. & B. Nicoll, Sydney. As she left the ways she was named the Lismore, by Mrs. Nicoll, Dalhousie Terrace. She is the fourth vessel built for the Messrs. Nicoll by the Messrs. Gourlay. Her tonnage is 350 tons gross register, and her engines are 50 horse power. The steamer is of a superior class, and is to be employed with the others belonging to the firm, in developing a steam shipping trade with the northern coastwise ports of New South Wales. In less than half-an-hour after the vessel was launched, her engines and boilers were put on board. Her dimensions are, length 150-ft., breadth 22-ft., depth 10-ft.

R. W. Boyd.—On the 12th February, there was launched from the iron shipbuilding-yard of Messrs. John Readhead & Co., South Shields, a screw-steamer of the following dimensions, namely, length 249 feet; breadth 32 feet 4 inches; depth of hold, 17 feet 6 inches. The steamer has been built to the order of Messrs. Wilson, Taylor, and partners, North Shields. She will be supplied with engines of 120-horse power, also built by Messrs. Readhead & Co. The vessel is about 1,800 tons burden, will be classed 100 A 1 at Lloyds, and will be employed in the Mediterranean trade. The vessel was named the R. W. Boyd by Miss Pearson, of North Shields.

Cornelia.—On the 13th February there was launched from Messrs. Palmer's yard, Jarrow, an iron screw steam yacht, built for the Marquis of Londonderry. The Marchioness of Londonderry performed the ceremony of naming the steamship, the Cornelia. The yacht is of the following dimensions:—Length over all, 200 feet; length between perpendiculars, 180 feet; breadth, 25 feet; depth of hold, 13·7 feet; tonnage 500 tons. She will be engined by a pair of engines of 100-horse power nominal, erected by Messrs. Palmer.

Violet.—On February 14th, Messrs. Laird Brothers, of Birkenhead, launched from the Birkenhead Iron Works, a paddle-steamer, which was named the Violet by Mrs. Hick, wife of Mr. Hick, M.P., one of the directors of the London and North-Western Railway, acting as sponsor. The Violet is built for the London and North-Western Railway Company's express passenger service, between Holyhead and Dublin, and is somewhat larger and more powerful than the Rose and Shamrock, built by the same firm for the same service in 1876, and has considerably finer lines, rendered possible by the saving in weight effected by the adoption of steel for the entire construction of the hull, which the company determined upon, owing to the satisfactory results obtained with their steamer Isabella, built of that material by Messrs. Laird in 1877. The steel used in all these vessels has been manufactured by the company at their Crewe Works, whilst in the engines some parts are of steel supplied by Whitworth & Co., and others by the Landore Siemen's Company. The dimensions of the new steamer are—Length between perpendiculars, 300 feet 6 inches; beam, 33 feet; depth in hold, 14 feet; tonnage, O. M. 1,626 tons; and she will be fitted with a pair of oscillating jet condensing engines, supplied with steam from eight boilers, calculated to exert an actual power of over 3,000 horse power, and to drive the vessel 17 knots, or nearly 20 statute miles an hour. The engines and boilers are completely erected in the shop, and ready to go on board, and it is expected the trial will be made in about a couple of months.

Oakville.—On the 14th February, Messrs. W. Gray & Co., launched, at West Hartlepool, a new iron screw steamer, built to the order of Messrs. R. Shadforth & Co., of Sunderland. The dimensions of the new steam-vessel are :—Length between perpendiculars, 241 feet; breadth, 33 feet; and depth of holds, 18 feet 3 inches by 22 feet 3 inches. She is classed 100 A 1 at Lloyd's, and her gross tonnage is stated to be 1,340 tons. Engines, 120-horse power, by Messrs. T. Richardson & Sons, of the Middleton Ironworks, Hartlepool. The vessel will be commanded by T. W. Watson, of Hartlepool, and will carry a deadweight of 1,900 tons. As she left the ways she was christened the Oakville, by Mrs. R. Brydon, of Hartlepool.

Haydn.—The steamer Haydn, built to the order of Messrs. Jenneson Taylor and Co., Sunderland, has just been launched from the shipbuilding-yard of Messrs. Joseph L. Thompson and Sons, North Sands, and is now being fitted with engines of 180-horse power by Mr. John Dickenson, of Palmer's-hill Engine Works. The dimensions are :—Length, 260 feet; breadth, 36 feet; depth of hold, 20 feet 6 inches; to class 100 A at Lloyd's, on the two-decked grade, no 'tween decks being laid, and each hold being divided by iron bulkheads. As will be seen, the dimensions of this vessel are greater beam and less depth of hold in proportion to the length than has been customary in steamers built during recent years; and as this vessel is principally intended for the grain trade from the Black Sea and America, the Owners have had her designed in these proportions for the better security of carrying such cargoes in bulk.

LAUNCHES (SCOTCH).

Toronto.—On the 27th Jan. Messrs. Charles Connell & Co· launched, at Scotstown, the Toronto, an iron screw steamer of 3,280 tons gross, the second of two they have built to the order of Messrs. Flinn, Main, and Montgomery, Liverpool, for the Mississippi and Dominion Steamship Company (Limited). The Toronto, like the sister vessel, Montreal, is built with several extras beyond the requirements for the highest class at Lloyd's for three-decked steamers, and besides having accommodation for a large number of passengers, is fitted with all the latest improvements for the cattle trade—special attention having been paid to the ventilation and water supply. As the vessel left the ways, she was named by Mrs. James M. Thomson, and was immediately towed to Finnieston Crane to get her machinery put on board, which is being supplied by Messrs. John and James Thomson, Finnieston Engine Works.

Balgownie.—On the 29th Jan., an iron screw steamer, named the Balgownie, was launched from the building-yard of Messrs. Alex. Hall and Co., Shipbuilders, Aberdeen, the dimensions of which are:—Length, 235 feet; breadth, 31 feet; and depth, 17 feet. The vessel is of 120 horse-power, and 1,150 tons register, the owners being Messrs. J. and A. Davidson, Aberdeen.

Donata.—On Jan. 31, the London and Glasgow Shipbuilding Company launched at Govan a screw steamer, built to the order of Messrs. Bahr, Behrend, and Ross, Liverpool, on account of the "Linea de Vapor Serra," for their trade between Liverpool, Spain, and Cuba. The vessel has been built to the highest class of Lloyd's and French Veritas, her dimensions being 210 by 28.6 by 16, gross tonnage about 700 tons, and will be fitted by her builders with compound surface condensing engines of most approved description for economising fuel. The vessel was named the Donata by Miss Fanny Hamilton.

Jorge Juan.—On Feb. 11th, Messrs. Archibald M'Millan and Son launched from their dockyard at Dumbarton the Spanish Royal Mail steamer, Jorge Juan, for the line of Messrs. Olano, Tarrinaga & Co. This vessel, which has iron and teak decks, and water-ballast in double bottom, is intended to carry the mails, troops, and passengers between the various stations in the Spanish Phillippine dependencies, and is fitted up with every convenience for passengers. The engines are by Mr. Rowan, of the Elliott-street Engine Works. The tonnage of the vessel is about 1000 tons register, and the engines are 800-horse power indicated.

Gloamin'—On the 11th Feb. there was launched from the Caledon Shipbuilding-yard, Dundee, an iron screw steamer, built to the order of Messrs. R. A. Mudie and Sons, by Mr. W. B. Thompson. The vessel, which is classed 20 years at Liverpool, is schooner-rigged. Her gross register is about 800 tons, and she will be fitted with compound surface condensing engines of 85-horse power nominal. The dimensions are :—Length over all, 210 feet; breadth of beam, 27 feet; and depth of hold, 14½ feet. Miss Gertrude Mudie launched the vessel, and Miss Meta Mudie named her the Gloamin'. Both young ladies are daughters of Mr. James Mudie, one of the owners. The Gloamin' will be employed in the Baltic trade.

Jane Hunter.—On the 12th February there was launched, by Mr. John Watt, from his shipbuilding-yard, Dysart, Fife, a clipper barquentine of the following dimensions, viz. :—Length over all, 112 feet; breadth, 24½ feet; depth of hold, 12 feet 6 inches; of 231 tons register, was built under special inspection to class 11 years A at Lloyd's. On leaving the ways she was named the Jane Hunter by Mrs. Boyd, daughter of the Builder. She is owned by Mr. William Gibson and others, Greenock, and is chiefly to be employed in the West India trade.

TRIAL TRIPS.

The Badibou.—A steamer 105 feet long, 16 feet beam, and 8 feet deep, has just been built to the order of the Marseilles House of Gounelle et Fils, for opening up the River Gambia, on the west coast of Africa, 200 miles from its mouth. The vessel, which is named the Badibou, is fitted with compound surface-condensing engines of 30-horse nominal power. She is fore and aft schooner-rigged, and will carry 60 tons dead weight on a draught of water not exceeding 5 feet 6 inches. She is classed 80 A 1 at London Lloyds, and on her recent trial trip with a full load she attained a speed of over nine knots upon the measured course at Long Reach, her engines working satisfactorily. She was built by Messrs. Edwards and Symes, of Cubitt-town, and was completed ready for the trial trip within ten weeks of the order for her construction being received.

The Tisza.—On the 29th January this new steamer ran her trial trip on the Clyde. In running the measured mile the speed attained is stated to have been 11 knots, which, considering the state of the weather and the fact of the steamer being so light that her screw was six feet out of water, was satisfactory. On returning to Greenock the vessel anchored at the Tail-of-the-Bank. The Tisza, which was built by Messrs. Blackwood and Gordon for the Adria Steamship Company, of which Messrs. Burrell and Son, of Glasgow, are the Managing Owners, is under the command of Captain Lee, and proceeds to Cardiff to load coal for Palermo.

Weatherall.—The trial trip of the steamer Weatherall took place on January 31st. The steamer has been built by the Tyne Iron Shipbuilding Company, to the order of Messrs. Fisher, Renwick and Co., of Newcastle-on-Tyne, and the engines have been constructed by the Wallsend Slipway and Engineering Company (Limited), and are 22 and 44 by 30-inch stroke. The boiler is of steel, made by the West of Scotland Steel Company, and carries a working pressure of 100 lbs. After the compass was adjusted, the vessel was run to the northward, in order to test the performance of the engines, which gave satisfaction; but the vessel being perfectly light, no definite results were obtainable. The Weatherall sailed on the following Monday, when another trial was held, and with steam at 100 lbs. in the boiler and 72 revolutions, an indicated horse power was obtained of about 440, and a speed of ship of over 10 knots. The glands of the high-pressure engine were fitted with metallic packing, and the engine is also supplied with other details to provide for a working pressure of 100 lbs.

The Laxham.—On the 3rd February the screw steamer Laxham was taken on her trial trip. The Laxham has been built by Messrs. John Redhead and Co., South Shields, to the order by Mr. Robert Harrowing of Whitby. The Laxham is 243 by [illegible] has a gross tonnage of 1,300 tons, and will carry a dead weight of 1,850 tons. Her engines (of 110-horse power nominal) have also been built and fitted by Messrs. Redhead and Co. The vessel was taken out to sea, and after having her compasses adjusted, was taken to the north and south of the harbour, and the trial proved very satisfactory, the vessel maintaining a speed of over 11 knots per hour. The vessel loads immediately for the Mediterranean.

Billiton.—On February 9th the new steamer Billiton, built by Messrs. Blackwood and Gordon for Lee King Yong, of Singapore, went down the Clyde on her trial trip. She left Port Glasgow, at 11 o'clock, and steamed straight to Wemyss Bay, where she ran the measured mile down and up. The mean speed attained was at the rate of a little over 10 knots an hour, which, taking into account the unfavourable condition of the weather, was considered quite satisfactory. The Billiton afterwards went up Lochlong as far as Ardentinny, and then turned, and steamed to Port Glasgow.

Resolute.—On February 4th this vessel, built by Messrs. Alex. Stephen and Sons for the Dundee Seal and Whale Fishing Company, had a very satisfactory run down the river. The engines, by Messrs. Pearce Brothers, were found highly efficient, and the registered speed against the tide to the Bell Rock was 9½ knots. By the courtesy of Captain Yule, the Directors and Friends were landed at the Bell Rock, and were delighted by this unexpected visit to the celebrated lighthouse. The keeper and his assistants showed the party every attention, setting forth the conveniences and comforts of their ocean home, explaining the working of the revolving light, and all the mysteries of their housekeeping on the solitary rock. Though comparatively so near at hand, yet it was a fortnight after the sad disaster before these men heard of the fall of the Tay Bridge. The trip up the river was rendered all the more pleasant by an excellent lunch, provided by Mr. Bruce, the manager of the Company. After the usual loyal toasts, the builders, engineers, captain, and success to the Company were specially pledged. The guests were landed at the Camperdown Dock early in the afternoon, all greatly delighted by their day's outing.

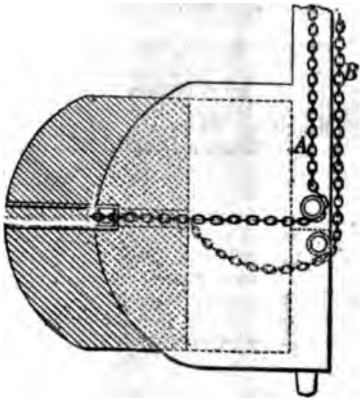
The Jeune Amiral.—On February 18th the new French steamer Jeune Amiral, of Havre, from the shipbuilding-yard of Messrs. Dobie and Co., Govan, and engined by Mr. William Kemp, Govan, Glasgow, made a trial at the measured mile, when the speed of nine knots, loaded, was attained. After a short cruise the vessel brought up at the Tail-of-the-Bank, where she will remain for a few days to finish her equipment for the voyage to Maranham (Brazil), to take her station, under the command of Captain Briere, in the cattle trade of that coast and of the Amazon, for which traffic she has been specially designed.

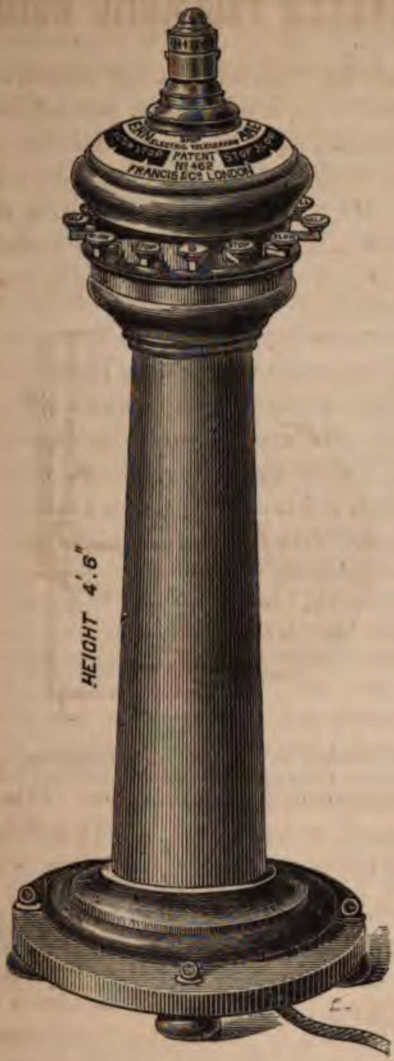
The Loch Garry.—On February 19th the Loch Garry, the latest addition to the Loch line of steamers, left Dundee, with a party of the owners on board, and sailed down the river to test her engines. The vessel is shortly to leave for Alloa to load for one of the lower Baltic ports. Captain Fraser, formerly of the Loch Leven, has been appointed to the command of the new steamer.

Sunbeam.—This tug-boat, which has been built by Messrs. Lewis and Co., Blackwall Point, and engined by Messrs. Alex. Wilson and Co., Vauxhall Iron Works, Wandsworth Road, had a trial trip on the measured mile at Long Reach, on the 17th February. The engines worked most satisfactorily during the day, and a mean speed of 9·64 knots was attained, with and against the tide. The engines are high pressure, of 30 h. p. nominal, and have two cylinders, 12in. diameter and 14in. stroke. Dimensions:—62ft. 4in.; beam, 13ft. 6in.; depth, 6ft. 11in. The tug is intended for towing barges on the Thames from the Docks upwards. On the 20th February it towed six barges, containing a total of 530 tons, at a speed of 7½ miles per hour, the tide being a very slack one, not running more than half-a-mile per hour, owing to the quantity of land water coming down. The owners are Messrs. Reading and Palmer, Commercial Road, Lambeth, S.E.

STEWART'S TELESCOPIC RUDDER.

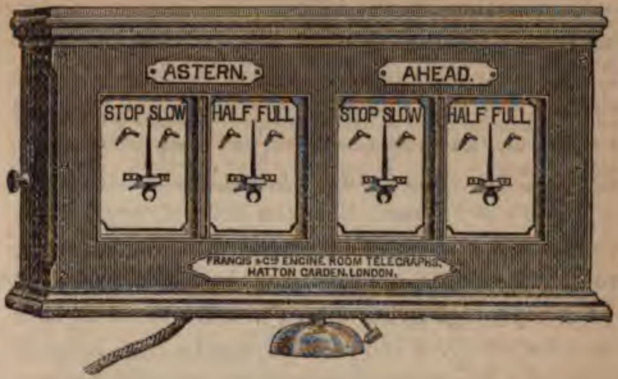
As vessels have increased in size, length, and speed, so the difficulties of steering them promptly and easily have augmented, and, as a consequence, numerous methods of obtaining greater steering power have been proposed. Mr. Stewart's mode of effecting this desirable end is by making the rudder of a telescopic construction, as shown in the accompanying figures. Fig. 1 shows the rudder in its normal condition, similar in external appearance to an ordinary one. It is, however, constructed of two side plates, joined together by means of distance pieces top and bottom, having a recess between them to contain the extra rudder. By means of the chain, A, this extra rudder may be drawn out, as shown in Fig. 2. B is a chain for drawing the extra rudder in again as required. This rudder is chiefly intended to be used in conjunction with steam steering apparatus, on which provision is made for working the chains A and B by means of friction clutches or otherwise. When the rudder is in its normal condition, as shown in Fig. 1, it is of about the same size as an ordinary rudder, or, if anything, a little smaller; and, of course, it is easily and quickly worked. Should, however, an emergency arise, requiring the course of the ship rapidly altering, as in the event of a threatened collision, an order might be given—"Double hard-a-port or starboard." Such an unusual order would, in the first place, show that there was a pressing necessity for its being promptly obeyed, and, in the second place, the "extra rudder" would be immediately drawn out, the steering power increased, and what might otherwise have been a serious accident possibly avoided. A model of Mr. Stewart's rudder was exhibited at a meeting of the Society of Arts on Wednesday, the 28th January last.



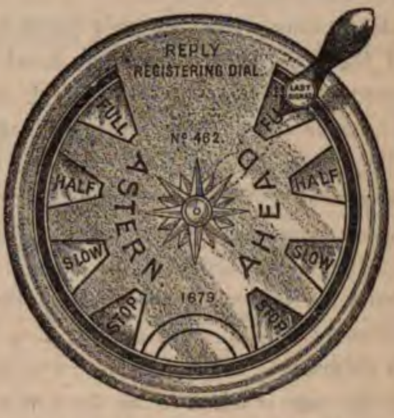

HEIGHT 4'.6"
PATENT
Nº 462
FRANCIS & Cº LONDON

SHIP TELEGRAPHS.

For some time past public attention has been arrested by the introduction of what are called "Steering and Engine-room Telegraphs," invented by Mr. F. R. Francis the Telegraph Engineer. This subject alone being of such great importance, assisting in the safe navigation of our ocean marine, we have carefully and professionally examined the apparatus in all its details, parts, and purposes, for upon its merits alone does a thorough revolution appear to us most inevitable; its simplicity, efficiency, and reliable character, rendering it a perfect system. A Company has been formed for the purpose of purchasing the patent rights, and thoroughly developing the invention.


ASTERN.
AHEAD.
STOP SLOW
HALF FULL
STOP SLOW
HALF FULL
FRANCIS & Cº ENGINE ROOM TELEGRAPHS.
HATTON GARDEN. LONDON.

The construction of the apparatus, as applied for transmitting engine-room orders is shown in the accompanying drawings. A is a pedestal, having a capstan-like top, fixed in a convenient position upon the bridge or deck; B is the engine-room indicator, placed in the engine-room, in a position where it can easily be seen and heard from the starting platform; and C is the reply-registering dial, also fixed in the engine-room, within convenient reaching distance from the platform. These are all electrically connected by wires, and the necessary electricity is supplied by a constant battery. The capstan-like top of the pedestal, A, has (in this instance) eight transmitting keys, placed round it as shown, much in the same way as the keys on an ordinary Wheatstone A B C telegraphing instrument, and marked "Stop," "Slow," "Half-speed," "Full Speed Astern and Ahead" respectively. There is a separate wire for each pair of these keys, and each wire is connected to one of the four needles of the engine-room indicator. If any one of the keys is pressed down—as, for instance, the "Full Speed Ahead"—the corresponding needle in the engine-room indicator is deflected, as shown. At the same time the attention of the engineer is drawn to it by a


REPLY
REGISTERING DIAL
Nº 462
FULL
HALF
SLOW
STOP
ASTERN.
AHEAD
FULL
HALF
SLOW
STOP
1879

continuous ring of the bell, a gong, as seen underneath it. He has then to acknowledge the order on the reply-registering disc, C; as soon as the handle is placed over the corresponding division, a similar bell is rung on the bridge or deck, informing the officer there that his order has been properly transmitted and understood, at the same time the deflected needle reassumes its vertical position ready for the following order. Meanwhile, the depressed key and the handle of the reply-registering disc, C, continue to register the order last given and received, until a fresh order is given, and the cycle of operations repeated for this fresh order. By the arrangement, it is impossible to give or to acknowledge a false signal, as the engineer can only reply to the signal sent, and the officer on deck can transmit but one signal at a time, so that every acknowledgment by the engineer is positive assurance that the particular signal sent has been received and acted on.

In these telegraphs, wires, properly protected, take the place of the rods, shafts, bearings, bevel wheels, &c., of mechanical telegraphs, and electricity is the substitute for their actual movement; so that, in the first place, the system of shafts, wheels, &c., which is liable to heavy wear and tear, variations from varying temperature and straining, rapid corrosion, being rendered inoperative from breakage, or being fixed, by slight accidents, or disuse, is replaced by the wires, which are properly covered and isolated; they have no movement in themselves, consequently no wear and tear, and if reasonable care is taken to lay them where they cannot be accidently injured, they should be practically perfectly secure; and in the second place the transmitting element is electricity, on which for years the safety of our railway trains has been placed, and found to be most reliable. The constant battery supplied with the apparatus is guarranteed to continue working the signals and bells continuously for two years, and a duplicate spare one is also sent, which can be readily substituted by disconnecting and re-connecting two wires. The battery is placed in any convenient position where it will be secure from accident between decks.

This system compares equally favourably with pneumatic telegraphs, which are so liable to derangement from leakage or injury to the rubber bags or pouches.

The special provision for repeating and registering the last order given seems to make it almost impossible to make any mistake, and certainly to prevent any dispute as to what it really was.

It is quite needless for us to further point out to our readers the advantages of this system, as there are few who have had any practical experience at sea who cannot remember numerous accidents and disputes arising from the defects of the usual method of transmitting engine-room orders; and doubtless many of them have frequently had to receive these orders verbally through the engine-room skylight through the breaking down of the signalling apparatus. We have seen numerous testimonials from officers of high distinction in the Royal Navy and Mercantile Marine, speaking of the satisfactory method in which they have been fixed and the certainty with which the signals are transmitted. We append one from Captain John J. Cartwright, United States Navy, which, though brief, is to the point, and is a fair specimen of the rest:—

From Captain John J. Cartwright, *United States Navy.*

"The steering and engine-room telegraphs answer first-rate, and, if better known, I feel sure, would be generally adopted. For large ships there are many advantages, and even in small craft, especially steamers and yachts, many dangers might be avoided by their use. Steamers fitted with the two systems may be considered as safe on passage as in dock, and *insurances should be effected at lower premiums.* For keeping a ship to her course, steaming through roadsteads, and getting into harbour nothing better could have been invented."

This system commends itself, and as we understand that the whole apparatus can be fixed aboard any ship in a few hours, at one half the cost of any other, we cannot but think that the "Navigating Telegraphs Company" now formed for their sale has a prosperous future before them.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from January 20th, 1879, to February 19th, 1880.

Prepared especially for The Marine Engineer *by Fell & Wilding City Patent Office, 23, Rood Lane, Fenchurch St., London, E.C.*

240. Jas. Henderson, Junr. Steam Boilers.
256. G. Quick. Breechloading Mechanism for ordnance and projectiles.
266. W. C. Church. Circular Slide and Sluice Valves.
272. E. W. Halliday. Steering Apparatus.
285. E. Robinson. Balanced Slide Valves.
300. A. Macklin. Protection of lofty or exposed bridges and other structures from the direct force of the wind.
314. W. M. Bullivant. Rope Stoppers.
325. J. and G. Bentley. Cut off motion for steam engines.
335. G. and J. Weir. Heating feed water of steam Boilers.
344. J. Reimami. Indicating water level in steam boilers.
352. W. H. Daniels. Screw propeller.
367. A. Barclay. Long span bridges.

368. T. Trebell. Anti-fouling composition for ships bottoms and submerged structures.
374. R. M. Marchant. Steam condensing apparatus.
375. J. Tate. Stopping steam and other engines.
408. G. F. Redfern (communicated by J. Russell). Combined floating dock and lift.
426. W. E. Gedge (communicated by L. E. Chagrot). System of screw propeller and rudder facilitaing evolutions of vessels and fitting on board.
443. J. Fricott. Screw helm.
456. J. Whyte. Anchors.
473. H. E. Newton (communicated by A. L. G. Delme) Crosseheads for motive power engines.
495. A. M. Clarke. (communicated by A. M. Mayer). Sopophone, apparatus for determining the direction relatively to the place of observation of a sound producing instrumentality; applicable more especially to navigation of vessels in a fog.
499. G. and A. S. Bower. Lighting with compressed gas and apparatus therefore, applicable to railway and other carriages, ships, buoys, and isolated buildings.
509. W. H. Mallory. Torpedo boats or fish torpedoes.
551. J. Thompson. Means for securing grain cargoes.
554. A. Longsdon. (communicated by A. Krupp). Apparatus or machinery for attaching and working guns or ordnance, applicable to turrets, forts, shields &c.
593. M. Rees. Paint or compositions for covering bottoms of ships and other exposed structures &c.
639. A. Bell. Filtering and heating feed water.
645. A. Davidson. Raising sunken ships and other submerged bodies and means employed therefor.
949. W. Morgan-Brown (communicated by G. Mazza) Injectors serving also as condensers.
651. J. Turnbull. Steam engines.
665. S. Hallam and G. L. Scott. Motive power engines and generators.
667. A. Specht (communicated by A. Petersen). Machinery for controlling steering apparatus, and ensuring the action of the rudder in accordance with the orders.
670. E. A. Brydges. Rotary Motor.
695. W. R. Lake (communicated by C. E. Chinnock). Cables or conductors for telephonic and telegraphic purposes.
706. W. R. Lake.(communicated by H. Load). Anti-frictional bearings.
718. J. D. and R. D. Napier. Governors.
737. G. H. Smith and H. B. Barlow. Lubricating.

PHOSPHOR-BRONZE COMPANY.—The sixth annual meeting of this company was held at the City Terminus Hotel, Cannon-street, on Friday, the 20th Feb.; Mr. JAMES ROCK, J.P., in the chair.

The notice calling the meeting, and the minutes of the last meeting, having been read by the Secretary (Mr. R. Lagerwall), the report of the directors previously circulated amongst the shareholders was taken as read.

The CHAIRMAN said that he had a few words to say in reference to the present position and future prospects of the undertaking. Whilst expressing the pleasure he felt at meeting the shareholders, he had at the same time to regret the absence of one of the directors, Admiral Sir Edmund Commerell, who had official duties to attend to. With regard to the report, he thought he might fairly say, and that they would all agree, that it was a satisfactory one. It appeared from a statement, furnished to him by the secretary, that since the first year's trading of the company the sales had increased 515 per cent., and the orders which, in 1874, numbered 529, were 2,000 last year. During all that time the capital ranking for dividend had increased, and they had yet been enabled to maintain a uniform dividend of 10 per cent., which, he thought, was most satisfactory in the dull times through which they had passed, and he felt very gratified to call the attention of the shareholders to that fact. The customers of the company now numbered little short of 1,000, consisting of corporations and firms, and, what was of considerably greater consequence, was that the order sheets increased in length, both as regarded the amount and the value of the orders, and what was still more gratifying, was, that as well as getting new customers they retained their old customers showing that they were well satisfied with the company's manufactures. They continued to receive orders from the Government as well as from Sir W. G. Armstrong, the eminent artillerist, as well as from the Midland and other railway companies for the metal, whilst there was a considerable increase in the export trade, the company's metal becoming known in all parts of the world. They were receiving orders from the British and Dutch East Indies, Australia, China, and Japan. The heavy castings for steamships, which was an important part of the business of the company, was found to answer most satisfactorily, the bearings had been working in a mail steamer twenty-seven months, wearing only one sixteenth of an inch, and not having had to be interfered with by the engineer. In conclusion, he begged to move that the report and accounts be received and adopted, and that the dividend at the rate of 10 per cent. per annum, free of income-tax, recommended therein, be declared.

Mr. FOSTER, in seconding the adoption of the report, said that he thought that the shareholders might naturally congratulate each other on the present position and future prospect of the company's affairs.

THE CHAIRMAN said that he should have mentioned that they had secured premises comprising offices and workshops of the most desirable description in Sumner-street, Southwark.

THE CHAIRMAN stated that the question of securing a quotation for the shares on the Stock Exchange had been under consideration, and he knew of no difficulty in the way of obtaining one. The most important patents held by the company had eight-and-a-half years to run, but others expired at an earlier date. They charged such moderate prices for this metal, that he believed the company would have a very good business at their command when the patents no longer existed.

THE ONLLWYN AND DULAIS COLLIERIES.—We are pleased to see that the Onllwyn and Dulais Collieries Company, Limited, have had a so far successful first issue of shares that they are now issuing a further instalment of working capital at a premium of 5s. per share. This company appears to be justified in doing this on two very good grounds. First, because the value of coal and iron, which is also found on the Onllwyn and Dulais estates, has gone up considerably in price since the first issue. And second, because an advantageous contract has been effected on the 12th of February, 1880, with responsible parties for the working the iron ores and small seams of coal on the estates of the Onllwyn and Dulais Collieries, but which this Company did not propose to work themselves. So advantageous is this contract to the company, that they hope to derive these under a profit of from 8 to 10 per cent. on their capital, in addition to their own earnings, as set forth in the original prospectus.

The grounds for making this second issue, appear to be very reasonable, and one stated to be intended to increase the financial reserve of the company, by not calling up the alloted shares to their full value, and also to give another opportunity to those who were disappointed in their first application (owing to excess of applications), to avail themselves of this second opportunity.

It may be noted that the present rate of premium is estimated to be sufficient to clear off the preliminary and other expenses of formation and issue, amounting to the moderate sum of only £500.

Advices received last evening from New York state that the owners of a line of steamers recently established between New York and Leith, have contracted with a Scotch iron firm to bring 100,000 tons of pig iron and rails to New York during the coming season.

The Vosper four-cylinder engine has recently been very successfully applied to the steam launch, Red Gauntlet, owned by Mr. Balfour. It replaces a single cylinder engine, and although the boiler is small, ample steam is provided to drive the engine to full power. The reversing gear is placed under the control of the helmsman, there being no dead centre, and the arrangement affords great convenience.

Notes and Novelties

The Engine and Iron Works at Gateshead-on-Tyne are in full work, or nearly so. Messrs. Hawks, Crawshay, and Messrs. Abbot and Co., the Tearns Rolling Mills, and Messrs. Palmer's and Co.'s Mills at Jarrow, are all doing a large business; and Sir Wm. Armstrong and Co., at Elswick, have a large stock of Spanish ore, and their blast furnaces are well employed, and will be for some time. Messrs. R. and W. Hawthorn, in all departments of their extensive establishment at Newcastle, are doing well. Sir Wm. Armstrong and Co. are building an iron lighthouse for China.

Rosetta.—The iron steamer Rosetta, built by Messrs. N. Sara and Sons, Penryn and Falmouth, to the order of Messrs. H. Deeble and Sons, went on her preliminary trial trip on the 24th ult The Rosetta is 65 feet long, 12 feet broad, and 7 feet 6 inches deep; fitted with compound surface-condensing engines of 25-h. p. nominal, also built by the Builders. The engines worked without the least tremble from starting, and everything went on most smoothly. The Rosetta being intended for passenger traffic and towing purposes, she is built under Board of Trade inspection, and is most elegantly fitted up, no expense being spared on her. She is very fast indeed, and has quite the appearance of a yacht with her large and ornamental funnel.

New Screw Propeller.—At the Royal United Service Institution, a paper by Captain J. W. Sadler, descriptive of his invention for a double rudder and moveable propeller steamship, was read. The author says he has discovered successful means of placing the screw behind the rudder, and, beyond the advantage of this, benefits of a collateral character arise. At present the screw is placed before the rudder, getting damaged. Great vibration is thus caused by the water from the screw washing against the rudder. Great vibration was also caused by the racing of the engines. The machinery was also frequently injured therefrom. To avoid this, ships were frequently constructed to excessive depth, which prevented their navigation in shallow waters. The writer claimed that by his invention excessive depth will not be necessary, as the semi-diameter of the screw will be below the bottom of the ship, and what is taken from depth can be added to beam. He has devised a system for raising the speed or depressing it, and hence ocean steamships can pass through shallow water. Steerage difficulties would also be overcome.

A New Deep-Sea Sounding Apparatus.—In taking soundings at great depths, and in places where there are strong under-currents, one difficulty is that the line being carried off by the undertow, the length paid out does not represent the vertical distance to which the weight has descended. A new apparatus, based on the effects of fluid pressure, has been recently described to the Lisbon Academy of Sciences by Senhor Henrique de Lima e Cunha. It consists of a cone of sheet copper, having as its base a copper diaphragm, perforated with six small holes, and screwed to it. A vertical wire of pure silver occupies the axis of the cone. To prepare the apparatus for use the wire is moistened with nitric acid, producing a thin film of nitrate of silver. The base being screwed on, the cone is suspended by means of a ring at its apex, and sunk by means of two weights or stones suspended by cords or chains depending from three rings attached to the perimeter of the cone. To insure a vertical position, a small float is attached just above the ring at the apex. As the apparatus sinks the water penetrates through the holes of the diaphragm and gradually rises in proportion as the pressure increases during the descent. The salt water acts on the thin coating of nitrate of silver on the wire, and turns it perfectly white by production of chloride of silver as far as immersion has taken place. Thus is ascertained how the high water has risen in the cone, and therefore what the pressure has been, and from these data the depth can be inferred by simple formulæ. The author suggested that by suspending the lower weight by means of an apparatus which would detach it on striking bottom, the instrument would ascend to the surface of itself, thus dispensing with the use of a line.

BOARD OF TRADE EXAMINATION.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act of 1854, during the month.

Note.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Dales, Isaac	2 c	Hull.
Welcome, S. J.	2 c	do.
Walker, W.	2 c	do.
Shores, W. W....	2 c	do.
Begg, Arthur ...	2 c	Leith.
Lovie, G.	2 c	Aberdn.
Burnett, Alex....	2 c	do.
Hay, James	2 c	do.
Mathison, Peter	2 c	do.
Cruickshanks, W	1 c	do.
Fraser, Andrew	2 c	London.
Adamson, D. B.	1 c	do.
London, T.	1 c	do.
Tyler, J. J.	1 c	do.
Duguid, Thos....	1 c	do.
Thorpe, Joseph	2 c	N. Shlds
Smith, Robt. ...	2 c	do.
Haswell, Wm....	2 c	do.
Sibun, Wm. ...	2 c	do.
Hale, Wm. Jno.	2 c	do.
King, James ...	2 c	do.
Rose, Joseph ...	2 c	do.
Noble, Charles	2 c	London.
Ritchie, John K.	1 c	do.
Steyhenson, S....	2 c	Lvrpool.
Lorentzen, C. A.	2 c	N. Shlds
Venus, Ralph ...	2 c	do.
Liddle, Nicholas	2 c	do.
Law, John C. ...	2 c	do.
Elliott, Robert...	2 c	do.
Clarkson, A. M.	1 c	do.
Raimes, George	1 c	do.
Dobson, Thomas	1 c	do.
Middleton, J.W.	1 c	Hull.
Fullen, Thomas	2 c	London.
M'Kenzie, Jno.G.	2 c	do.
Moore, George...	2 c	do.
Hamilton, Robt.	2 c	do.
Archer, Jas. B.	1 c	do.
Wills, John......	2 c	do.
Taylor, Alfred E.	2 c	do.
Dewar, Robert	1 c	do.
Adams, A McD	1 c	do.
Tompkins, E. H.	1 c	do.
Meston, Alex. ...	1 c	do.
Perkins, Harry	2 c	do.
Brodie, Archibld	2 c	Grnock.
Dewar, Alex. ...	2 c	do.
Marshall, M. ...	2 c	do.
Houston, James	2 c	do
Wallace, David	2 c	Grnock.
Summers, Wm.	2 c	do.
Rush, John.......	2 c	N. Shlds
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Scott, James ...	2 c	do.
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Dunn, James ...	2 c	do.
Anderson, Alex.	2 c	do.
Dykes, John ...	2 c	do.
M'Bean, Duncan	2 c	do.
Fernie, W. E. ...	2 c	do.
Murray, John...	2 c	do.
Grimes, T. B. ...	2 c	London.
Lanceley, Fred.	2 c	Lvrpool.
Bell, Chas.	2 c	Plymth.
Whister, George	2 c	Sndrlnd.
Simpson, Alfred	2 c	do.
Snaith, T. F. ...	2 c	do.
Hutchinson, J.	2 c	do.
Sinclair, W. C.	1 c	do.
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M'Naught, John	1 c	Liverpl.
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Parks, Barton ...	1 c	Liverpl.
M'Elheran, D....	1 c	do.
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Horan, John ...	1 c	do.
Anderson, Jas.	1 c	do.
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ROBERT WALKER'S PATENT HYDRO-CARBON FURNACE AND APPARATUS

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals, &c.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel, burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; one ton of Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of 3000 to 4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in the case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c.
8.—Cleanliness.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to existing furnaces, and the steamships, &c., without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

THE INVENTORS' RECORD.—"Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S., (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with the coal."

THE RAILWAY RECORD states, "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers."

The MARINE-ENGINEER.—"For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage."

INDUSTRY.—"At a trifling cost an enormous degree of heat was easily attained, estimated at 5000 degrees by which iron was easily melted in ten minutes, instead of taking in ordinary circumstances two hours, and gloss in two hours instead of sixteen.

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"These advantages are immense, and must eventually effect a complete revolution in our present mode of steam generation."

For prices, &c., and for terms for working this patent under royalties or licences or otherwise, apply to the patentee, Mr. R. Walker, 19, Buckingham-street, Strand, W.C.

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All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication; but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

The Marine Engineer,

LONDON, APRIL 1, 1880.

EDITORIAL NOTES.

IT is decided that a fresh Arctic Expedition to the North Pole will start in the month of May, 1881. It is considered advisable to postpone the start until next year from the fear that the General Election now coming off will so interfere with the collection of subscriptions for the purpose that the possible departure would be delayed too long after spring. We cannot but admire the dogged persistence and pluck for which our countrymen have long been famed in this fresh attempt to reach the farthest recesses of the ice-bound North. At the same time it seems but puerility and good money thrown after bad unless this new expedition starts prepared and resolved to effect more than was done in the last abortive attempt. We see that great dependence will be placed this time upon the assistance of a gigantic train of balloons to convey the exploring party from the ice-bound ships to the comparatively inaccessible pole. There is much to recommend the possibility of success to this enterprise, from the fact that the great difficulty in access to the North Pole is impassable nature of the hummock ice which is found in a broad belt around the pole beyond the points to which ships have been able to penetrate. These hummocks prevent the use of sledges over them, and thus the hardiest explorers on foot have been stopped when within a comparatively short distance of their goal. It is proposed when the ship shall have reached its furthest accessible position, to wait a favourable wind, its curvature and direction being reported to the ship by at least three independent stations connected by telegraph. When the wind should be fair to the North Pole it is proposed that the exploring party should commit themselves to a large compound balloon vessel, taking with them some fifty days' provisions and a boat or sledge. This seems a very simple and practicable aëronautic expedition. The elevation need not be at all high, probably within reach of trail ropes all the while, which probably might be very effective for partial steering of the balloon. The sun would be up day and night, the landscapes would be unsurpassed for extent and novelty, and the speed might be probably that of a slow train. What a charming way of visiting the mysteries of the Arctic Circle. There is but one danger to our mind, and that is how long the successful explorers might have to wait for a favourable return breeze back to their ship. It might be awkward to be weather-bound at the North Pole. We are, therefore, not quite so sanguine as the sailor, not having his grounds for confidence, who believed that what had been done once might be done again, for as he said, "If there is a North Pole, somebody must have put it there."

THE *Quilis* and her guns must be or ought to be giving a good deal of anxious consideration to our Naval Authorities. First it is not flattering to our naval supremacy to know that one of the youngest naval powers is possessed of an ironclad with armour and armament more powerful than any we possess. It will be remembered that her armour is 22 inches of steel plating, not only over her gun turrets but over the whole of the vital part of the ship, including the engines and turret machinery. This armour cannot be pierced at ordinary ranges by any of our guns. At the same time her 100 ton guns are capable, if up to their work, of discharging a 2,000-lbs. shot at an initial velocity of 1,700 feet per second, representing a total energy of 40,000 feet tons. This is sufficient to penetrate the armour of any of our ironclads afloat. What such a vessel could effect against even a fleet of our ironclads is startling to consider, when at the same time it is remembered that the *Quilis* can steam at a speed of 15 knots an hour, a greater speed than that of the *Inflexible*, her only approximate equal in our navy. On the other hand again the destruction of one of the 100 ton guns tends to throw a very grave doubt indeed upon the whole system of gun construction in the form of shrunken wrought iron coils over a steel inner tube. It is evident that whatever circumferential strength this system may give to a gun, there is no longitudinal homogeneity between the rings of the coils to prevent separation of the breech from the muzzle, as soon as the steel tube has been ruptured. In the case of the 100 ton gun the rupture fortunately took place after the discharge and was entirely in a longitudinal direction not circumferential, or else not a man would have been left alive in the turrent. The only way to obtain perfect homogeneity is to use such a material as cast steel. Perhaps this material will now have a chance of a fair trial.

THE subject of the adaptation of merchant steamships to warlike purposes is now receiving a considerable amount of attention. The country has a naval scare at least at every two or three years' interval. The navies of the European powers are dragged forth in formidable array to terrify us if possible by the alarming result of all the European navies banded against us. It is surely out of the ordinary course of events to suppose that we should ever have to stand alone against the united navies of Europe without an ally. But, even if so, we have an unrivalled mercantile marine, and it would surely not take us long to equip many of our best Atlantic and other liners so as to be capable of very valuable offensive and defensive operations. In offence their speed alone when fitted with a suitable ram would make them most dangerous opponents to many iron clads much more heavily armed and armoured than themselves. For defence it would not be difficult to fit up many of our ocean steamers with protection to their vital parts and machinery by coal bunkers, to other parts the protection of wool, grain, sand or timber. It must not be forgotten that so feasible was this arrangement that when war appeared imminent some two years ago the Admiralty were prepared at the shortest notice to fit out 30 ocean going steamers as fast cruisers. There is no doubt that the average ocean liner is sufficiently well built to prove a powerful light armed cruiser. Her strength for ramming is well shown by the comparative impunity with which an Atlantic steamer lately rammed an iceberg at full speed. There are those, however, amongst whom we may mention Mr. Donald Currie, who believe that there are not more than 80 British steamers suitable for conversion into cruisers. There is no doubt that if the probable conversion for after cruising purposes was borne in mind when the ocean going steamers were being built, arrangements could be devised and additional strength given where needed to render them exceptionally valuable additions to our navy when wanted. This, however, would probably cause some additional cost to the ship owners. Would it not pay Government to subsidize the building of such ocean going steamers so as to enable them to form a naval reserve in case of emergencies. We should be glad to aid by publicity any designs or suggestions of our readers for such special arrangements in ocean going steamers as would aid their rapid and effective conversion into war steamers, without interfering at the same time with their first cost or convenience and capacity for passenger and goods freights.

THE strike of the ship-yard men at West Hartlepool is now at an end. The men in the yard of Messrs. Whitby & Co., having been replaced by Shipwrights from other parts, old workmen collected at the gates of the yard and hooted the newcomers, but there was no serious disturbance.

MR. EDMUND THOMPSON, well known in connection with the shipping trade, has just died, after a long illness, and was buried at Benhilton Churchyard on Saturday afternoon March 20th. Mr. Thompson, who carried on business in London, was the inventor of life-saving apparatus which had been tried with a great measure of success before the chiefs of the Admiralty.

ON CAUSES OF UNSEAWORTHINESS IN MERCHANT STEAMERS.

By B. MARTELL, Esq., Chief Surveyor of Lloyd's Register of British and Foreign Shipping, Member of Council. Read at the Twenty-first Session of the Institution of Naval Architects, 17th March, 1880. Lord HAMPTON in the Chair.

THE loss at sea of many steamers during the last few months, involving great sacrifice of human life and immense destruction of property, has drawn more than usual attention to questions of safety in the Mercantile Marine.

The probable causes of such calamities have been scanned from different points of view, and the possibility of more adequately providing against similar losses in the future has been strongly and rightly insisted on.

As too often has happened before in many of the recent disasters, all hands have perished, so that no certain information has been obtainable to indicate the cause of loss, and we are therefore left to draw conclusions as best we can by deductions from general experience and circumstances, and the facts elicited from survivors who have been providentially saved from some of the vessels that have foundered.

Information of the latter kind would be invaluable if we could always depend upon its accuracy, and on the absence of exaggeration. Few men, however, at moments of extreme danger, have either the coolness or the leisure to note correctly what is passing around, and whose memories can be trusted to convey afterwards an exact narrative. At least that is my experience after many investigations. This it is which in a measure leads to so many conflicting opinions, as we see daily in the press, and hear in shipping circles.

There are, however, some facts which stand out only too clearly as elements of danger, and to these I hope to draw your attention, as well as to some others of importance, though perhaps not in so great a degree. And I think I shall be able to show you that some important misconceptions exist as to the causes of loss, which create unwholesome prejudices and do positive injury by withdrawing attention from the real sources of evil. It will be well, perhaps, in the first place, to run over a list of the several causes assignable for shipping disasters before discussing their relative importance.

We have then—

1.—Weakness of structure from deficient scantlings, combined with faulty construction in arrangement and workmanship, together with inferiority of material.

2.—Deterioration, causing local defects and unseaworthiness.

3.—Absence of proper control over cocks, valves, and pipes connecting the engines and boilers with the sea. Also a want of proper arrangement of bilge pump suctions, and of suction pipes from sea and bilge, whereby water, from inadvertence or carelessness, can be run from the sea into a vessel.

4.—Faulty and deficient pumping arrangements, preventing the accumulated water being pumped from the wings in turn of bilge, after a vessel, from shifting cargo or other cause, has become inclined.

5.—Breaking down of machinery, and the consequent falling off of the vessel into the trough of the sea.

6.—Bad navigation—leading to collision or vessels running ashore.

7.—Inefficient protection of openings in the deck.

8.—Hasty and improper loading, particularly of grain cargoes in bulk, and deficiency of shifting boards or bulkheads, or other means to prevent cargo from shifting.

9.—Disproportionate dimensions of steamers, combined with undue height of double bottom, thereby causing, with some description of cargoes, deficiency of stability.

10.—Overloading.

Of the foregoing sources of danger it is not too much to say that all have, at some time or other, claimed their victims, but in connection with recent disasters special prominence has been given to the last three or four, and as a full consideration of all the causes I have named would extend beyond the necessary limits of this paper, I purpose dealing principally with these latter, while at the same time glancing briefly at the others in the order in which they are named.

1.—As regards structural weakness and inferiority of materials used in building cargo-carrying steamers much has been publicly said and written respecting this, both by those whom it was right to assume had some knowledge of the subject, and by others who had little or no acquaintance with ship construction, and the inference which some of these persons desired to have drawn respecting the unknown losses of many of these vessels was, that they broke in halves from inherent weakness and so disappeared in mid-ocean.

It may, however, be said that these conjectures are not founded on any *known* evidence, and that on the other hand, from the experience of hundreds of similarly built vessels, as well as from scientific calculations, it is easy to show there was abundant structural strength—and, besides this, amongst the items of information which have been gathered from the unhappy survivors of some of these vessels which have foundered, there has not been a particle of evidence in this direction, but it has invariably pointed to other causes of disaster which will be hereafter alluded to.

From all the information I have been able to obtain from outside sources on this side of the Atlantic and the other, and from my own experience, and that of our large staff of Surveyors whose duty it is to carefully survey all classed vessels on their arrival home from foreign voyages, I am justified in stating emphatically that the causes of these recent losses must be sought elsewhere than in the want of structural strength.

2.—That danger sometimes arises from local deterioration has been abundantly shown by experience, and the names of the *Magæra*, *Atlantic*, and others, will readily occur to every one in proof of this. It is also fully recognized that this danger has been rapidly diminishing since the practice of cementing the inside of iron ships has become universal, and since it has equally become an object with every one to make all parts of the structure easily accessible.

Instances could of course be adduced where, owing to inferior cement being used, the plating of the bottom, $\frac{8}{16}$" thick, has been eaten through from the effect of a sugar cargo within six months from the date of launching.

I may instance that only within the last few weeks an iron vessel which had carried sugar cargoes amongst others was found to have as many as eighty of the iron floor plates eaten through, and which had either to be renewed or made good by doubling plates.

The effect of galvanic action is also sometimes observed from the contact of copper pipes or roses with the outside plating, where the latter is not properly protected by cement.

All these instances I need hardly say show the importance of careful periodical surveys, particularly in vessels which were built before cement was generally adopted for the inside protection of the bottom plating.

3.—As regards sea cocks, much might be said on this head. There is no doubt that the loss of many steamers have in the past arisen from an injudicious arrangement of cocks, valves, and pipes in connection with the machinery and the sea. We have only to remember the loss of the *La Plata*, and the narrow escape of the *L'Amerique*, and other vessels which could be named which have mysteriously filled with water at sea, not to mention the cases of vessels which have filled and sunk in docks, to convince us that there have been, and still to some extent exist, silent dangers in the engine-rooms of steam vessels, which require careful supervision.

This danger has doubtless within the last few years considerably diminished as nearly all steamers now built have all cocks, valves, &c., in connection with the sea, fitted above the stoke-hole plates or platform, so that at all times they can be seen and kept in proper and safe working condition.

4.—Much greater attention has been found to be necessary, as to pumping arrangements, than was till lately thought requisite, so as to ensure adequate means of pumping the vessel out by the engines at any angle of inclination in which she may be placed. It is of the greatest importance that sufficient suction pipes should be led from the different compartments to the engine-room of steamers, and that these pipes should be connected not only to the bilge-pumps on the main engines, but to the donkey-pumps also, so that the whole of the steam pumping power in the vessel may be applied whenever required. Where double bottoms are fitted for water ballast, attention is also now paid to the arrangement of suction pipes, so as to enable any compartment to be wholly pumped out under any condition of the trim or position of the vessel. These have in past times been found common sources of inconvenience and of danger, for when a steamer was inclined and water had gathered in the bilges, it was not always the case that proper suction pipes existed to enable the steam pumping power to be used, and failing this, the water has continued to accumulate until the fires were put out and there were no means of righting or saving the vessel. It is only right to add that in steamers now being built this subject is generally receiving very careful attention.

Fig. 1 shows a steamer having a deep tank for water ballast in the fore-hold, and double bottom for water ballast under the engine and boilers, and also in the after-hold. By the arrangement of suction pipes, sluices and pumps, it will be seen how water can be pumped from any compartment at any angle of inclination of the vessel, and it is only by such, or a similar arrangement, that water which may have found its way into a steamer can be entirely kept under control.

5.—Breaking down of machinery.

Th greater experience acquired in the management of steamers has forced upon owners and managers the necessity of a special and careful examination of the engines on the return of the vessel from every foreign voyage, and the employment of superintendent engineers, in order to avoid the risk of a break down, and the attendant consequences which may follow, not only in the loss of the vessel, but of delay and cost in putting into a foreign port for repairs.

Too much importance cannot be attached to this, as from the great proportionate length of steamers now built, the smallness of sail-power often provided, combined with the non-effectiveness of the rudder under sail alone while the screw-propellor remains attached, render it almost impossible to keep a vessel to any particular course, and hence the risk in falling off becomes enormous, with a low freeboard and small margin of stability. In having to encounter heavy seas under such circumstances, the danger can scarcely be magnified, and it arises perhaps from a slight casualty to the engines which by careful supervision before leaving port might have been obviated.

And here I may mention another point of great importance that leads to a similar danger to the foregoing, and has unfortunately led to many disasters. I allude to the too frequent breaking of rudder chains, or the disabling in other ways of the steering gear. Cargo steamers being often steered amidships from the bridge, the rudder rods and chains have to be led long distances, and sufficient care may not be taken in fitting the sheaves properly for the rods to work over, or the leads for the chains may not be so fair as they should be.

At any rate, from one cause or another, accidents in this direction have happened too often, and when from want of sufficient propelling-power to keep her course safely, which is too often the case, a slow, deep-laden steamer has to adapt herself to a course safe and practicable, this position and her safety depend entirely on the rudder not being disabled.

The strains at such times brought on the chains and rods are very severe, and unless the material and workmanship be exceptionally good, every blow from a heavy sea becomes a trying ordeal, for if anything should give way nothing can prevent the vessel from falling off into the trough of the sea, and being placed in imminent peril. This has very recently been shown to arise even in one of the largest American liners. This vital part to the safety of cargo steamers is often, it is feared, paid less attention to than its importance merits.

6.—Bad navigation, leading to collisions, or vessels running ashore.

On this point I am not called upon to speak professionally. Indeed were it otherwise I should not feel myself competent to do so before an audience composed largely of naval officers. But that bad navigation prevails, and prevails largely, we see from the records of collisions in our newspapers and Law Courts, and the numerous findings of Courts of Enquiry that vessels were run ashore through the neglect of soundings and other preventible causes.

At the same time my experience leads me to believe that the officers of the Mercantile Marine have considerably improved of late years. Whatever may be said to the contrary, the examinations they have to pass to obtain their masters' certificates tend to raise the educational standard among them without impairing in the least their practical knowledge; on the contrary, a higher intelligence enables them more accurately to read the teachings of experience. It is fortunate that this is so, for as steamers grow in size and value from year to year the enormous value of the property, and the number of lives committed to the charge of these men goes on increasing, as well as the difficulty of handling such monsters. When we come to consider other causes of loss arising from overloading and improper stowage, it will be impossible to acquit shipmasters of all blame, but it must always be remembered of them that, whatever may be their faults of omission or of commission, they always risk and too often have to pay the penalty of their lives in return for their mistakes, whether they arise from ignorance or inadvertence.

7.—I have mentioned the question of inefficient protection to engine and boiler openings and other openings in the deck, and this is one to which I have before drawn attention; but I fear due importance is not yet given to it. From want of due precaution in this, and in failing to provide proper coverings for stock-holds and fastenings for coal bunkers, pipes, or hatches, many losses I feel certain have occurred.

When we hear of the funnel and ventilators being washed away in some of our largest passenger steamers, with decks 10 or 12 feet above the water, what are we to expect if proper attention is not given to these vulnerable parts in deeply-laden cargo ships with a freeboard in some instances not exceeding 4 feet?

Notes of warning have often been sounded in this direction, and the difference of these dangers in different trades has been insisted upon; but still the special requirements needed are often not realized or applied to the extent they should be.

The demand for cargo steamers during the last year or two for the trying Atlantic trade, and the generally-depressed condition of other trades, have caused many owners to send vessels across the Atlantic in midwinter who doubtless would otherwise scarcely have thought such vessels suitable.

Perhaps it will tend to throw light on the development of steamers for the various cargo-carrying purposes, if we glance at the earliest steamers so engaged, and notice the alteration of types as they became increased in size and number.

The employment of steamers for special cargo-carrying purposes alone had its rise on the North-east Coast for the coal-carrying trade, and from this type of vessel may be traced the various alterations throughout their development to adapt them to the general purposes of the trade for which they are now employed.

The earliest steam vessels built for the coasting trade were about 150 feet long, 25·6 broad and 15·6 deep. The more recent vessels employed in this trade have been increased to 220 feet in length; the only alterations of importance made in the later vessels in addition to increasing their size, being to increase their relative fulness of form; whilst the earlier vessels had a co-efficient of tonnage fineness of ·72, many of the later ones have been increased in fulness to ·77.

As the steam-carrying trade became developed, and steamers became built for longer voyages in the Baltic and Mediterranean, greater length was given than in the earlier vessels, while all the objectionable features of extreme fulness of form and flatness of floor were retained. Two principal causes doubtless operated to retain these features in cargo steamers.

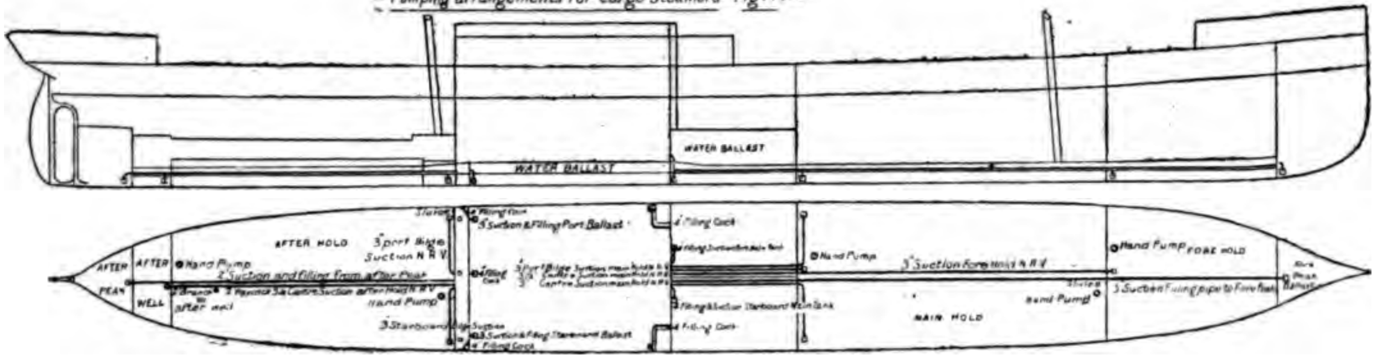
In the first place it was thought, the less the area of midship-section to drive through the water under the same displacement, the less the propelling power required. And secondly, that as steamers differed so widely from sailing ships in having no top-weight of heavy masts, and their stability consequently, when light was so much greater, that there was less necessity to have a rise of floor to insure sufficient stability in shifting when discharged. Consequently, the two great advantages were obtained of having a flat floor, viz.: the reducing the draught of water with the same displacement, and the carrying the greatest cargo under the same principal dimensions, whilst being able to place the engines and boilers as low as possible. The result of this has been to destroy nearly all beauty of architectural form in a large proportion of sea-going cargo steamers, by producing an approximation to a rectangular prism, whilst at the same time, as will be shown, it has at last been the means of introducing a positively dangerous element in this class of vessel.

The full flat-bottomed form for steam corliers was no doubt the most suitable for the intended trade, as the result of great speed was not so profitable as carrying a relatively large cargo. Moreover, the fitting double bottoms throughout the fore and after holds was also most economical and safe for such vessels, seeing they always carried similar cargoes, and were found by experience to have sufficient stability either filled with coals, or with water ballast alone. But it does not at all follow that vessels still further modified to suit general trades, where on one voyage they may carry iron ore stowed on the ceiling or inner bottom, and on the return voyage may be quite filled with grain or other homogeneous cargo, can safely be built of similar proportions and form, and similarly fitted with water ballast tanks throughout as in their prototypes the colliers. The growth, however, of elements of unsafety in the design of sea-going cargo steamers can be clearly seen, and may, I think, be traced as follows:—

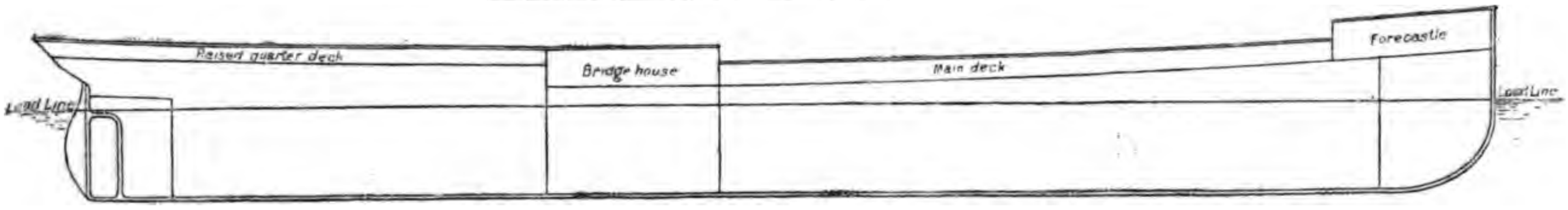
If we take a vessel of the same length as one of those recently capsized, and trace the alteration of type under which such vessels have grown from the flush-decked collier to the fitting of a raised quarter deck and monkey forecastle, and subsequently the short poop, bridge house and forecastle—and again the long poop or connection of poop and bridge house, extending from the stern to the front of the engine room; and from this to the spar deck, and finally to the complete three tiers of beams, having the full scantlings to the gunwale; we shall be able to form an opinion of the relative safety of such types of vessels as regards their stability alone, under the various conditions of loading now in practice.

The vessels referred to, which recently capsized when loaded with cargoes of coal and grain, were all vessels having full scantlings

—Pumping arrangements for Cargo Steamers—Fig. 1.—


WATER BALLAST
WATER BALLAST
AFTER PEAK
AFTER WELL
AFTER HOLD
Hand Pump
2" Suction and filling from after Peak
2" Branch to after well
3" port Bilge Suction N R V
Hand Pump
3" Starboard Bilge Suction
Sluice
3" Suction & Filling Port Ballast
3" Suction & Filling Starboard Ballast
4" Filling Cock
4" Filling Cock
4" Filling Cock
4" Filling Cock
3" Centre Suction main hold N R V
Filling & Suction Starboard Main Tank
Hand Pump
3" Suction Fore Hold N R V
MAIN HOLD
Sluice
Hand Pump
Hand Pump
FORE HOLD
3" Suction Filling pipe to Fore Peak
Fore Peak Ballast

—One deck steamer with raised quarter deck. Fig. 2—


Raised quarter deck
Bridge house
Main deck
Forecastle
Load Line
Load Line

to the upper deck, and were much alike in proportionate dimensions.

The following are the particulars of one of them :—

Length	245 feet.
Breadth	33 ,,
Depth of hold	23 ,,

Vessels of the same length as above, and from which it may be said the latter type of vessel has arisen, have been built 245 feet long, 32 feet broad, and 17 feet 6 inches depth of hold, having a long raised quarter deck about 3 feet 6 inches above the main deck. Such a vessel is shown in Fig. 2, and in fact illustrates one of this class of vessels now in existence. The draught of water when fully laden with coals, as indicated in the drawing, would be about 16 feet 3 inches, and by careful calculation it is found that the metacentric height would be 1·5 feet, so that such a vessel could be inclined to an extreme angle of 66° before arriving at the point of vanishing stability.

If we go further, and take a long poop vessel of the same length —that is, one having the poop and bridge-house connected—we shall find the dimensions of many such vessels now sailing to be, length 245 feet, breadth 32 feet, and depth of hold 17 feet 6 inches. The continuous erection on deck 7 feet high, would be about 150 feet in length, and the forecastle about 30 feet. Such a vessel is shown in Fig. 3, and there is practically no difference in the principal dimensions from the preceding. With a cargo of coals below deck, and only a small portion in the poop, such a vessel would draw about 16 feet 6 inches of water; and in this case the metacentric height is found to be 1·5 feet: so that this vessel, with a homogeneous cargo, snch as grain or coals, would have her maximum stability at 52°, and a considerable righting moment at 90° inclination.

By going a stage further we come to the spar-deck vessel. That is, one having the scantlings determined by the height to the main deck, and above this height the scantlings somewhat lighter. The dimensions of some of these vessels are—length 245 ft., breadth 32 ft., and depth of hold to spar deck 24 ft.

Here the same beam is retained as in the former vessel, and the erection above the main deck is made continuous by a complete deck all fore-and-aft.

It is customary to load such vessels to within a short distance of the main deck, according to the structural strength, &c., of the ship, as shown in Fig. 4, thus leaving between 7 and 8 feet of freeboard from the spar deck.

The metacentric height of such a vessel loaded to this depth with grain or coals, assuming the hold to be filled and a portion only of the space to be filled between the main and spar decks, is found on calculation to be 0·8 ft., the angle of maximum stability being 55° with a large righting force still in reserve at 90° inclination, owing to the high freeboard of this type of ship, thus showing, as in the preceding cases, that such a vessel would, if loaded as described, have an ample margin of stability.

Coming now finally to the vessel of the same length, and whose scantlings are continued of the full size to the upper deck, similar to the vessels referred to which have recently capsized, and whose dimensions, as before stated, were—length 245 ft, breadth 33 ft., depth of hold 23 ft., it will be observed that this vessel has one foot more beam than the spar-decked vessel, but a very striking difference will, at the same time, be apparent in the practice of loading this type of vessel, as shown by the position of the load water-line in Fig. 5.

While the spar-decked vessel is supposed never to be loaded below the main deck, and consequently has the space between the main and spar deck only partially filled with cargo, the latter vessel is purposely increased in strength so as to admit of the main, or rather the middle, deck being two or three feet below the water. The effect of all this additional topweight in the vessel above the main deck may be expected to render the stability small, and calculations show that the margin of stability, under such conditions, becomes dangerously low. In the case of the vessel I have been describing, whose constructed load line was within 4 feet of the upper deck, the metacentric height was only 0·7 feet. In other words, if the cargo shifted sufficiently to incline her through even a moderate angle, she would be in imminent danger of capsizing: thus scarcely creating surprise that such vessels have capsized, and that this has sometimes occurred a few days after leaving port.

Curves of stability of the different types of vessel referred to are shown on Fig. 6, together with an explanatory Table of reference, and the curve marked **A**, shows the stability of one of the "Three-deck" vessels referred to, loaded as I have described. It will be seen that it is exceedingly small and unsatisfactory. Curve **C** shows the effect which would be produced on this vessel by increasing the breadth two feet. The stability at moderate angles of heel is increased considerably by this step.

The effect which *depth of loading* has on the stability of the vessel is clearly seen by curve D, which shows that by increasing the freeboard one foot, and retaining the original breadth, a great gain in point of stability and safety is obtained even as compared with increasing the breadth 2 feet.

In this case, the maximum stability is increased from 25° to 40°, while the range of stability is extended from 52° to 80°.

From this it appears pretty evident that, whilst the types of steamers have been gradually altering through the stages described, from the flush-decked vessel of one deck and two tiers of beams, up to the vessel with two decks and three tiers of beams, or what is known as the "Three-deck" vessel, in each stage the topweight being increased and facilities afforded for deeper loading—the necessary stability has not been made commensurate with the requirement for the latter type of vessel, and hence there are a large number of cargo-carrying steamers now in existence of this class to which great care will have to be applied in loading, particularly the smaller ones, when they are conveying homogeneous cargoes, if she accidents with which we are acquainted are to be avoided.

The question, however, is not only how are we to deal with similar vessels in existence, but also how is the safety of this type of vessel to be improved in building others? One of the most essential changes is to increase the beam. Another of not less importance is to provide a greater freeboard. And here it may be interesting to draw attention to other tendencies which have kept the relative beam of steamers small, in addition to the belief, as before stated, that a small midship-section was an important element as regards speed. Steamers when light are stiff, compared with sailing ships, and when in ballast are uneasy, and tend to strain themselves if the beam is too much increased. They also have frequently to take in heavy dead-weight cargoes, and without the special arrangements for the stowage of such cargoes ordinarily adopted being carried further than at present, broader vessels would labour heavily. Considerations of this kind have tended to keep cargo steamers narrow, and as they frequently carry heavy dead-weight cargoes on one voyage followed by light cargoes the next, causing great differences in their stability, the design in most favour under such circumstances has been a compromise, in order to meet these various requirements.

The greater original cost, and the expenses in working steamers as compared with sailing vessels, have also made rapid dispatch in port a question of greater importance; the consequence of this has been that too little attention has been given to the stowage of cargoes of different specific gravity in steamers, and they have too often been supposed to be sufficiently safe, whether loaded with a cargo of iron ore on the ceiling, or filled with a cargo of grain.

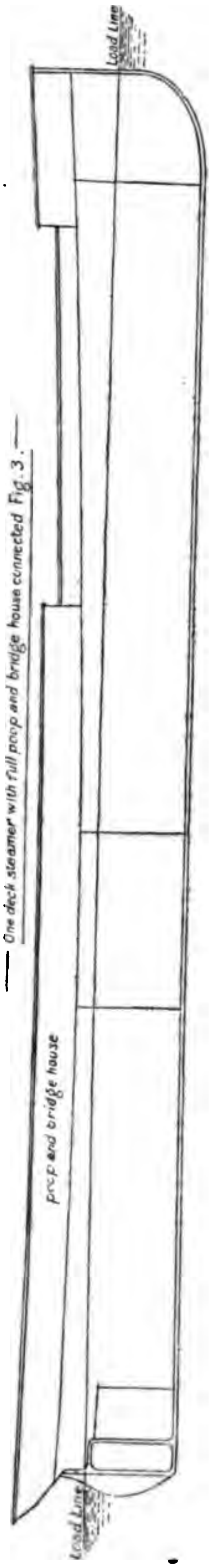
No compromise, however, in form or proportions, will ensure immunity against laxity of this kind, and unless in loading them those who are in command exercise more intelligence as to the question of stability, and are guided more by experience, as has been the case with sailing ships, similar accidents will recur, whatever provision may be made to prevent them.

In consequence of nearly all the steamers which have foundered this winter being fitted with double bottoms, it has been associated in the minds of many with the direct cause of these accidents, and viewed with disfavour by underwriters and others affected by these losses.

It should, however, be borne in mind that nearly *all* the cargo steamers now built are fitted with double bottoms, so that the fact of the vessels lost having double bottoms follows as a matter of course, and is no indication of the cause of these disasters.

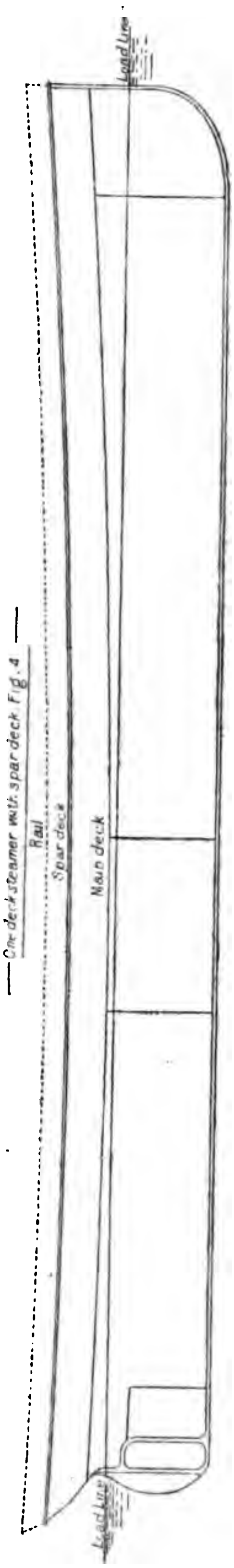
That the double bottoms fitted to these vessels have in consequence of insufficient beam in some cases contributed to their loss, there can be no doubt, but from the remarks one hears all round it is evident that much misapprehension exists as to the influence which these water-ballast tanks have on the capsizing of vessels of this type. It is supposed by many that, in addition to raising the cargo, the double bottom, being water-tight, has a lifting power inherent in itself to capsize the vessel. This I need hardly say to the Members of this Institution is purely fallacious, as the stability of the vessel is not affected one iota, whether the air in the double bottom is absolutely enclosed or in free communication with the atmosphere. These double bottoms are all fitted with air pipes, and if the air itself had any tendency to rise or to lift the bottom of the ship it would rise through these pipes, but not being beyond atmospheric pressure it has no such tendency.

The real source of danger to the vessel in fitting these tanks, I need not say, is in lifting the centre of gravity of a homogeneous cargo higher than it would be lifted by ordinary dunnage, and to this extent it renders a vessel more tender when loaded, and if her proportions and form make her otherwise a tender vessel, this influence might possibly render her dangerously unstable, and, with-



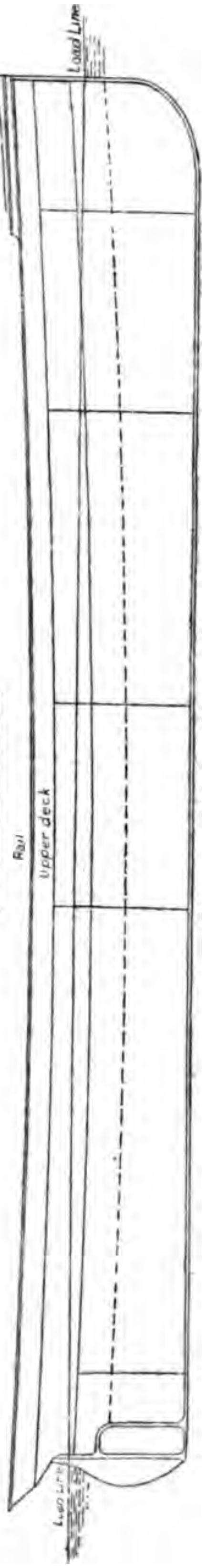
One deck steamer with full poop and bridge house connected Fig. 3.

Load Line
poop and bridge house
Load Line



One deck steamer with spar deck Fig. 4

Load Line
Rail
Spar deck
Main deck
Load Line



"Three deck" steamer Fig. 5

Load Line
Rail
Upper deck
Load Line

out doubt, some of the recent losses may be attributed to this cause.

This fact in an exaggerated form has led some to suppose that the fitting of these water ballast tanks in the bottoms of vessels is under *all* circumstances inconsistent with safety, but I need not say that no danger need be feared from this mode of construction provided the proportions and form of steamers be made suitable to the height and extent of the tanks, and an intelligent judgment be exercised in loading them. The carrying of water ballast has become so essential a part of the economy of steamers, that it will well repay the time and consideration necessary to ensure a combination of such a convenience with the safety to the vessel.

I have said that in cargo steamers it is necessary to effect a compromise between too little stability with grain and other homogeneous cargoes, and too much with dead weight, such as iron, &c.

I need not add that it is better to err on the side of the latter than of the former. One leads directly to unsafety, the other leads to uneasiness and straining, but only indirectly to danger; and this can be avoided, once it is understood, by lifting the dead weight cargoes.

None of the information gleaned from the survivors, and from other experience with vessels loaded with iron in the lower hold, goes to indicate that any actual loss has occurred from the vessel having *excessive* stability.

But here again we must not go to extremes, for even recently cases have occurred where steamers have been placed in some jeopardy from excessive stability and violent rolling, owing to iron being stowed too low in the hold. Beyond the greater risk of the engines breaking down, and of shipping heavy seas, it would be wrong to ignore the wear and tear, and straining action on the ship.

In passing it may be interesting to notice the following example of a new steamer, which recently made extremely heavy weather, and which has been attributed to the heavy dead-weight cargo of iron being stowed too low.

I have given in Fig. 6 an approximate curve of stability of this "Three-deck" steamer, marked "H," whose dimensions are 285 ft. by 35 ft. 3 ins. by 24 ft. 5 ins. This vessel recently sailed from this country to America with a cargo composed principally of iron. There were 1,700 tons of this stowed in the hold, extending up to within 2 ft. of the middle deck, and 300 tons between decks, and the approximate metacentric height in computed to be, when so laden, not less than 3 ft. 6 in. On her voyage she encountered heavy weather, and the consequence was that the vessel was severely strained. On her arrival at the port of destination it was found, on examination, that many butts of outside plating and rivets were started and the decks strained and leaking, besides other damage from the same cause. The difference between the curve of stability of this vessel, and that of the vessels loaded like those which have capsized, is very striking, and there is obviously room for abundant safety between them, free from any fear of excessive stability.

Experience thus gained, however, has led to improved loading on future voyages by raising the height of similar cargoes and placing a greater portion of the iron on the middle deck. This, as before said, merely requires experience and judgment, and need not occasion additional outlay. Such experience has to be gained in loading *all sailing* ships, and there is no reason why similar knowledge should not be acquired and exercised by those who have charge of steamers.

The dangers from loading heavy dead-weight cargoes can therefore be met without difficulty, but the principal danger arises, as shown from the recent losses, in carrying homogeneous cargoes, such as grain or coals, whose specific gravity admits of the vessel being filled to the upper deck. The inner bottom in such cases being a fixture cannot be removed, as portable dunnage can in a sailing ship, so as to admit of the cargo being lowered and stowed on the ceiling, and the question arises, How can "Three-deck" vessels, similar to those which have been lost, be adapted to carry such cargoes with a proper margin of stability and safety? With reference to those already built of these proportions the remedy will readily present itself, that if these sad accidents are to be prevented there must, when carrying such cargoes as grain or coals, be less cargo carried between decks, or more heavy deadweight below, as the case may require.

That narrowness alone does not involve danger, if proper judgment be exercised in loading, may be shown by illustrating the case of a spar-decked steamer which was referred to by Mr. W. John in a valuable paper read by him before this Institution in 1877. This vessel was 276 ft. long, and only 30 ft. broad, and and having a depth of hold to the spar-deck of 24 ft. She has *been employed up* to the present time principally in the grain trade, and on one occasion became disabled by an accident to the rudder chains when so loaded, and was abandoned. But though the cargo shifted and she was rolling about in a heavy sea for some days in the Bay of Biscay, she did not capsize. In fact, the calculation of the stability of this vessel at that time showed that she might have been inclined through an angle of 111 degrees before the point of vanishing stability was reached. The cause of this, however, was that the vessel was properly loaded, having regard to her proportions and consequent stability.

The hold was entirely filled with grain in bulk, and as much stowed between decks as experience showed she could safely carry without making her unduly tender.

The owners of this vessel are well aware that were she loaded quite full between decks, so that her main deck would be under water, as is the practice with most of the "Three-deck" vessels of the same total depth, in the first gale she encountered when so loaded, she would inevitably capsize.

Hence it is not only a question of beam, but also one of depth of loading.

Returning to the question of the "Three-deck" vessels having only a small margin of stability, for the purpose of seeing how this stability can usefully be increased with the least loss and inconvenience, let us assume the 'tween decks to have two transverse bulkheads, within which cargo is to be stowed, and suppose we thereby carry 80 tons less than at present, and suppose the tank in the after hold to be of a size to contain an equal weight of water, or to be divided by a water-tight division, as is now frequently done, this after-tank could be run up with water, and by retaining the same load line, a marked improvement in her stability and safety would be effected as shown by the curve B, the range of stability being extended from 52 deg. to 75 deg.

Here we have the simple question of less profit on the 80 tons ot coal or grain cargo, or a continuance of excessive risk, and from my knowledge of steam shipowners, I am of opinion there is not one would hesitate which to adopt when the two courses are clearly pointed out.

In the case of vessels about to be built, if we consider the dimensions of vessels now engaged in the grain-carrying and similar trades, in connection with the results of these calculations which have been given, we shall have no difficulty in arriving at one or more sound conclusions which I sincerely hope will be accepted, as it may tend to their increased safety. It may be said almost with certainty that many of these steamers combine in themselves many of the worst features which contribute to instability and consequent unsafety.

These are—

1st.—Small relative breadth to both depth and length.

2nd.—Great fulness of form throughout below the water-line and extreme flatness of floor.

3rd.—Low freeboard.

4th.—Undue height and extent of double bottom.

The remedies, as I before stated, are greater beam, a more shapely form, a greater freeboard, and a double bottom not deeper than necessary for the purposes of water ballast.

But notwithstanding that these suggestions may be adopted advantageously, and a more stable vessel be obtained, it still remains, if we keep to the present "Three-deck" vessels that we have a type of vessel intended in point of strength to be fully laden, but that when so laden having a very low freeboard, and therefore not the most suitable for encountering heavy seas.

And here the question arises whether the building of another type of vessel could not be encouraged which combines more elements of safety than the "Well" ship or the "Three-deck" vessel, and could perhaps be worked as economically.

Between the long poop and forecastle ship, having a high freeboard at each end, and a very low waist, and the full scantling "Three-deck" ship, with short coverings over the ends and engine and boiler openings, with a low freeboard nearly all fore and aft, it may be asked, and often is asked, cannot a type of vessel be devised with a good freeboard all fore and aft that shall be an equally good paying and safer ship. It seems a question capable of easy answer, but in reality it is mixed up with many others that open up a vexed field of enquiry. It is often asked why in cargo steamers of the long poop type, where the poop and forecastle together cover perhaps two-thirds the length of the ship, the further obvious and inviting step is not taken of covering the "*well*," and getting a good safe freeboard all fore-and-aft? The answer usually is that the prescribed draught of water of the vessel would not admit of cargo being carried in the new part, whereas the tonnage dues would be considerably increased. This question of tonnage measurement is indeed the great obstacle to improvement in the types of ships for the Atlantic trade, and especially the grain trade, as it handicaps both the awning-deck and the spar-deck type of ship, which naturally lend themselves to the maintenance of a good healthy freeboard and freedom from capsizing. I have given you an instance of one of these ships; a spar-deck vessel, which knocked about abandoned for days nearly on her beam ends with grain cargo. shifted in heavy weather, and did not capsize. In fact, she could not capsize, because only a small part of the cargo was between decks, and its total centre of gravity was sufficiently low to give the vessel in a measure the righting properties of a lifeboat.

The objection to the type is, that all this 'tween-deck space, which gives great safety to the ship, but earning no freight, has to pay tonnage dues, just as if the whole ship was filled right to the upper deck, and loaded two or three feet deeper.

Of course it may be said this tonnage question is an old one, and has been debated over and over again. This is quite true; but I think few believe it is satisfactorily settled, and it is to my mind so intimately mixed up with this great loss of life and property at sea, that this must be my excuse for again raising it. Where a vessel is covered with a lighter superstructure, such as an awning deck, for purposes of safety, and which cannot possibly be filled, or nearly filled with cargo, unless the ship is allowed to be loaded below the main deck, I would ask why the space actually occupied by cargo should not be measured, as is now done by the recent Merchant Shipping Act, with deck cargoes, instead of the whole space, or say a certain deduction made from the 'tween-deck space? No doubt there are difficulties in the way, but they are, to my mind, small compared to the great end that will be achieved, and I trust this Institution will give it their most serious consideration, and press it on the attention of the proper authorities.

It is only those intimately associated with the Mercantile Marine who see how often, day by day, sometimes comparatively in small things, the tonnage laws tend to prejudice the safety of ships.

When, for instance, it was found that low and inefficient wood coamings to hatchways in cargo steamers contributed to their loss in several instances, iron coamings came into existence; and as this material enabled the coamings to be made much higher without practical difficulty, a very beneficial change set in towards making them high, so as to reduce the chance of heavy seas forcing them in, or large bodies of water resting on them. This was discouraged by the space so enclosed being added to the tonnage measurement, and so adding to the working expenses of the ship.

The same may be said of the protection round the openings of the engine and boiler space. The best protection possible is an enclosed bridge house around the engine and boiler openings; but as the law at present stands, it encourages the ends of this bridge superstructure being left open instead of being closed by iron bulkheads.

I was much struck with this a few months ago, when I officially visited a large number of steamers in course of construction in the North for the Atlantic trade, and on pointing out to the owners or builders the desirability of continuing the bridge house to the sides of the vessel, and enclosing it so as to secure effectively the casings round the engine and boiler openings against heavy Atlantic waves, I was invariably met by the observation that it would add too much to the working expenses of the ship, as this space would be measured for tonnage.

Where builders and owners are willing to incur outlay in the first place to secure additional safety, it is rather too much to put a tax on them for this outlay for ever after.

These are all parts of the great question whether the tonnage laws could not be so amended as to encourage safety and safe types of merchant ships, rather than as at present tending sometimes in the opposite directions.

We all know that those who administer the tonnage laws are as desirous as any of us to contribute to the safety of life and property, and it is towards the *amendment* of the law, rather than to censure its administration, that my remarks are directed.

I now come to a branch of the subject that has for months attracted considerable attention, and it is one of great importance. I refer to the losses of grain laden-ships during the present winter. It may be in the recollection of many of my hearers that a series of almost unparalleled disasters occurred during the winter of 1872, and led to much excitement. I cannot help believing that the great attention the subject received at the period mentioned led to greater care being exercised by those responsible for the loading of grain cargoes in the succeeding years, for the losses were immediately reduced.

The losses of the present year have also produced considerable excitement, and show that this subject of grain cargoes still requires careful attention. This is a matter which unfortunately can only be controlled indirectly from this country, for the very simple reason that the vessels are loaded in foreign ports, and if from insufficient attention to the stowage by those entrusted to supervise it the vessel is lost on the voyage, neither the evidence nor the persons guilty of the negligence are forthcoming in this country for examination. The most we can hope to do at this Institution is, I fear, to make the perils of improperly-stowed grain cargoes known as widely as possible, and to point out the best practical remedies known to those who have given particular attention to the subject. That the cure for wholesale disasters lies within practicable limits may, I think, be taken for granted, and it is borne out by the improvement effected immediately after the disasters of 1872.

Further striking evidence of the same kind may be obtained from experience of the grain trade of Montreal. No port on the American Continent, it has been stated, suffered more from the loss of grain-laden ships than that port did previous to 1873; and it will be seen from the Table of Losses that within a period of four weeks during the winter of 1872, no less than six steamers grain-laden from Montreal either foundered or were missing. At Montreal, it may be known to many, they have a Port Warden, invested with certain powers over the shipping loading in the port. Up to the date in question, 1873, a shipmaster loading grain in the port was liable to a fine of $40 if he did not comply with the Port Warden's regulations.

This fine was so ridiculously low that shipmasters used to pay it as a matter of course, and load their ships as they liked, and numerous losses used to ensue.

In that year, however, the fine was raised to $800 for evading the Port Warden's regulations, and since that time *not a single grain-laden vessel* from the port of Montreal has foundered at sea.

These regulations, together with some unofficial ones, more or less enforced at the ports of New York, Philadelphia, Boston, and Baltimore, all stipulate for the fitting of shifting boards, and for carrying a portion of grain cargoes in bags.

We have shown that in the case of Montreal the measures now taken for enforcing the regulations are exceedingly stringent, and that they have been of late years exceedingly effective. The recent losses of grain-laden vessels we have to deplore have arisen among ships loaded at the United States and Black Sea ports, and the question naturally arises whether the rules for loading grain, set forth by the Surveyors to the Underwriters' Association at these ports, are fairly enforced. It has been objected that Montreal is scarcely a typical port, because the St. Lawrence being closed by ice during a portion of the winter the average losses may be expected to be less. But this certainly did not prevent the great losses which occurred from this port previous to the regulations of 1873.

When recently in America I had opportunities of observing the loading of grain in bulk by means of elevators, and the difficulty of properly filling the hold by such means is only too apparent. The continuous stream of grain which pours in produces a stiffling dust to such an extent that it is beyond human endurance to remain in the vessel sufficiently long to properly trim it, so as to fill the hold in the wings under the stringer plates and similar places.

To show the serious nature of this, I may mention that during my visit there, a steamer had left port so loaded, and after encountering heavy weather had to put into a neighbouring port, where it was found the grain had settled to such an extent as to require over twelve hundred bushels to fill the after-hold alone. Many opinions exist as to the settlement of cargoes of grain shipped in bulk during a stormy voyage, but there is no doubt it is greater than is generally supposed with the present despatch of loading.

Another instance of this I may mention, in the case of a "Three-deck" steamer recently arrived home from an American port, loaded with grain in the hold in bulk, sufficiently high to enable just two tiers of grain in bags to be stowed between the top of the bulk grain and the middle-deck beams. The depth of hold to the middle deck was 17 feet; and it was found that, on the removal of the hatches, though the grain had been stowed in bags on boards laid on the top of the bulk grain, these had settled so much in some places as thirty inches.

Somewhat similar instances may be given, where the grain had been stowed in bulk to a height of a foot or more above the hold beams, with bags on top stowed on boards, and extending up to the deck, and the vessel having put back, it was found that the bulk grain had settled below the beams and shifted, leaving the bags and boards resting on the beams.

The foregoing are sufficient to show that as at present loaded at some ports the grain in many of the vessels settles down to a considerable extent, thus rendering it impossible to keep the compartments full.

It must be evident that with such experience as this, shifting boards, fitted only 3 or 4 feet deep below the beams, as is often the case, are next to useless to prevent displacement of the cargo.

It is well known that all grain will settle somewhat on a long voyage even when it has been carefully trimmed into the wings and under the beams and stringers, some description of grain of course more than others. The large amount of settling down in grain cargoes which has recently been heard of, however, must be due in great measure as I have indicated to the haste with which the grain is run into the vessel's hold from the elevators, and which does not admit of its being properly trimmed under the beams and stringer plates. I have heard of steamers of from 1,200 to 1,800 tons laden in some of the American ports within ten hours, and where this is the case it is obviously impossible to attend to the trimming.

If we glance briefly at the conditions of grain-loading, they will be seen to be somewhat as follows:—

1. The simplest is that of vessels having only one deck, with or without hold beams, and carrying grain of such a kind that her holds can be filled without the vessel being overladen. Here, it appears easy enough to fill the hold with bulk grain, as has been customary from the Baltic and Black Sea Ports: and this mode with proper shifting boards, might not be unsafe, provided the grain be properly trimmed into the wings, and trodden down so as to obviate any danger of its settling materially during the voyage. In fact this practice has been adopted for years, and when adequate care has been taken it has been done successfully. Or, still better, the hold may be filled up to within a few feet of the deck with bulk grain, then properly trimmed and levelled and covered with boards, the remaining space up to the deck being filled in tightly with grain in bags. Shifting boards should, of course, be fitted as in the previous case, and it is of great importance that these should be sufficiently strong, and extend well down into the hold—in my opinion to the keelson.

2. The step from this is when the same ship has to carry a cargo of grain too heavy in its nature to enable the holds being completely filled without being overladen. This, perhaps, occurs oftener in sailing ships than in steamers, but the principle to be borne in mind in both is the same—viz., that, in whatever part of the ship grain is loaded, the cargo should reach to the deck. To carry this out, it is necessary to bulkhead off the part of the hold that is not to be utilized so that the remainder can be properly filled up. This has to be done with due regard to the trim of the ship and her depth of loading, but is often not sufficiently considered. If too large a space is left for cargo it may become a choice of two evils, as the vessel fills up, either of the vessel being overladen or the holds not being properly filled. Again, it has not unfrequently happened that these temporary bulkheads have given way through the pressure of grain as the vessel pitches at sea, when of course the surface would become free, and shifting would take place. When adequate precautions are taken against these contingencies this case resembles No. 1, and I need not further dwell upon it.

3.—The next typical case is that of a vessel having two complete decks laid, carrying grain of such a nature that her holds can be completely filled, and also between decks to the upper deck, without being overladen. This, I may state at once, is one of the most difficult and troublesome of all to deal with, as you will immediately see. The lower hold resembles the hold of the one-decked vessel, but with this difference: in the latter if, after all precautions have been taken, it is found the ship has got a list at sea, the hatches can be opened, if the weather moderates, and the grain can be retrimmed before it has gone too far, or it can be filled up from bags carried for this purpose.

In the former case, however, all access to the cargo in the lower hold is cut off by the cargo in the 'tween decks, and a slight list may go on increasing until it becomes serious, unless the lower hold is well secured against such a contingency. Again, the cargo in the 'tween decks itself may be capable of shifting, and thus the danger is two-fold in this type of ship as compared with a vessel having only one deck laid.

Many devices have been resorted to in these vessels for securing their safety, but they may be ranged generally under two heads based on two different principles.

One is to make the stowage of the lower hold complete and distinct in itself, securing the bulk grain by means of boards and bags on top of same, and with shifting boards extending, in some cases, down to the keelson, and carrying the remainder of the cargo between decks in bags. The other principle is to provide feeders to the lower hold from the 'tween decks, so that, in the event of the grain settling below, loose grain will run down to fill up the empty spaces.

It can scarcely be said of either of these principles that it is unsound, but much depends upon the way in which they are carried out. This is especially so in the latter case, for it is difficult with a deck laid to make the arrangements for feeding from the 'tween decks sufficiently perfect. This is especially so where the lower deck is of iron. Where it is of wood it is common for a few strakes of deck on each side near the stringer to be lifted, and these, together with the hatchways, fulfil, to some extent, the object of filling up the empty spaces in the lower hold caused by grain settling.

Where the deck is of iron, a series of small hatches are sometimes cut at the side for the same purpose, although frequently the communication is by no means sufficient to insure the lower hold being efficiently fed from between decks. Another important point to be borne in mind in reference to this mode of stowing grain cargoes, is that by feeding the lower hold from the 'tween-decks the risk of the 'tween-deck cargo shifting is increased.

Sometimes the 'tween decks is filled with a combination of bulk and bag grain, the bags being piled round the hatches and feeders, where loose grain is stowed in bulk. This has often been adopted with safety, but it is by no means perfect. It is not certain that the grain under the middle line hatches could find its way into the wings, and I have heard of instances which indicate that it does not always do so in cases of grain shifting; and although the same doubt does not apply so distinctly to feeders in the wings, they have another important drawback not generally noticed. In the case of the grain below deck shifting, and an empty space being left on one side, it will be clear that the feeders on that side might be called into play, and be emptied into the lower hold while the other side remained full. This, however, would obviously not cure the list of the ship, and is therefore not sufficient.

In some cases trunks have been led down from the upper deck to the lower hold, so that grain could be poured down from bags to fill up the empty space, in the event of the grain settling or shifting.

4.—The other typical case is that where the lower hold is filled with grain, but a portion only of the 'tween decks is filled as in the case with spar-decked vessels, and sometimes with "Three-deck" ships. In this case temporary bulkheads have to be fitted between decks to contain the latter, and the lower hold has to be made secure against shifting, as in the previous case. I have indicated in Fig. 6 that spar-decked steamers so loaded with the main deck out of water, may have great elements of safety, in consequence of their much greater freeboard, as compared with "Three-deck" ships of similar size, loaded as is customary; and it may be remarked that in the recent losses, not one of this type of vessel is to be found in the Table setting forth the particulars of these losses. Hence the desirability, which I must repeat, of encouragement being given to such a type of vessel with which this mode of loading is necessarily connected.

In the foregoing rapid sketch of the conditions of grain-loading, I have necessarily been compelled to confine myself chiefly to the principles involved, and have had to omit many variations in detail, and devices resorted to under the different conditions of loading which exist. I cannot, however, pass from this question of grain-loading without a word on the proposal to carry all grain in bags. This is a question that is now receiving investigation by a select Committee of the House of Commons, who will, I doubt not, arrive at a sound conclusion on the subject. That it would be more expensive there cannot be a doubt, and my inquiries have led me to the conclusion that this would amount in an American voyage to about 8¾d. per quarter, or say £360 per voyage in a vessel of about 1,200 tons nett register, including the cost due to delay in loading. That a cargo composed, partly of bulk and partly of bag grain, can be made as safe as a cargo containing all bags, is a question on which all practical men are agreed, and I think I have shown that behind the losses which have occurred there lie dangers from deficient stability and other causes which would not be cured by carrying all grain in bags, and my endeavour has been, so far as I have been able, to shadow forth the relative magnitude of the different sources of peril.

In fact, the figures themselves in the Table of Losses show that there were as many coal-laden steamers as grain-laden steamers lost during the months of the past winter; and although it is possible for coal to shift similarly to grain, it is not a cargo which is prone to shift, or which would be considered dangerous in a fairly-designed vessel. In view of these facts there is nothing to show that the inherent deficiency of stability of the vessels, loaded as they were, might not have been as active an agent, if not a more active agent, in creating the disasters we deplore as the shifting of the cargo.

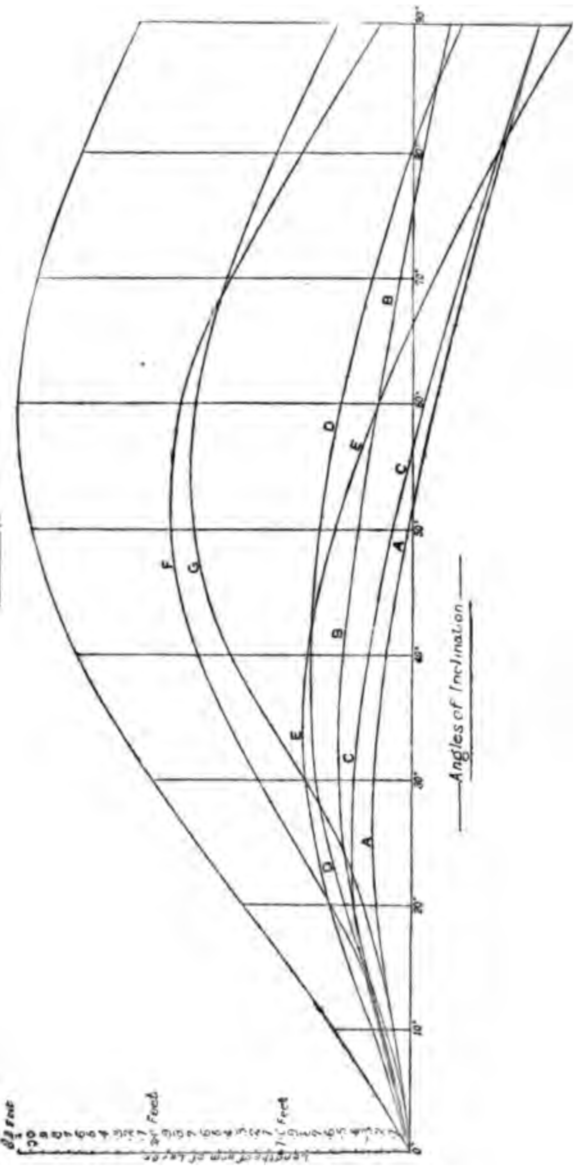
One other cause of danger, which I mentioned in the early part of this Paper, remains, viz.:—overloading, and I need not dwell upon it, for my views on that subject have been laid before this Institution at great length on previous occasions. That it is a serious

TABLE OF REFERENCE TO CURVES OF STABILITY.

Reference Letter.	Description of Steamer.	Register Tons under Deck.	Registered Dimensions.	Metacentric Height.	Maximum Stability at.	Maximum Righting Moment.	Righting Moment at 90°.	Freeboard.	Condition of Loading.
			Feet. Feet. Feet.	Feet.		Foot-tons.	Foot-tons.	Feet.	
A	"Three-deck" vessel	1,402	245 × 33·3 × 23	0·7	25°	1,080	None	4	Full cargo of coals or grain
B	Ditto ditto, with 80 tons of water ballast ...	1,402	245 × 33·3 × 23	1·2	32°	1,860	None	4	Ditto ditto
C	Ditto ditto, with 2 feet additional breadth ...	1,450	245 × 35·3 × 23	1·3	25°	1,540	None	4	Ditto ditto
D	Ditto ditto, with 1 foot more freeboard ...	1,402	245 × 33·3 × 23	1·3	40°	2,620	None	5	Ditto ditto
E	Raised quarter-deck vessel	1,050	245 × 32·3 × 17·6	1·5	33°	2,000	None	3	Ditto ditto
F	Full-poop vessel	1,000	245 × 32·3 × 17·6	1·5	52°	4,460	588	3	Ditto ditto
G	Spar-decked vessel	1,360	245 × 32·3 × 24	0·8	55°	4,800	1,647	8 ft. to spar deck.	Ditto ditto
H	"Three-deck" vessel	2,005	285 × 35·3 × 24·5	3·5	60°	11,800	8,094	6 ft. 6 in.	Cargo of iron, spiegel, &c.

source of peril will be evident from the calculations and diagrams I have laid before you, while it is a subject surrounded by enormous difficulties every one will admit who has attempted to deal with it; but it is hoped that, by attention being drawn to the subject in a manner to show the magnitude of the evils which result from it, this source of danger, which is getting less, will soon altogether disappear.

Figure 6



In conclusion, I have only to apologize for occupying so much of your time, but my excuse must be the interest now attached to the subject and its great extent, and my strong conviction that, unless reviewed broadly and somewhat comprehensively, misapprehensions might arise instead of the Paper leading, as I hope it will, to a full discussion of the subject, which at the present time has become a matter of public importance.

STEEL IN THE SHIPBUILDING YARDS.

THE above is the title of a very interesting and valuable paper read by Mr. W. Denny at the recent meeting of the Institution of Naval Architects, describing the experience of his firm in the use of mild steel. The first vessel built by them was the "Taeping" in 1876, since which time the use of this material has so extended that at present there is little else in their yard. During this period out of a consumption of about 7,000 tons of steel this firm has experienced only *six* failures in plates, and two or three in angles, and the majority of these failures could be distinctly traced to their having been worked at a black heat. Mr. Denny states, "This is the really unsafe thing to do with steel, and our foremen and men have now received instructions that it is not to be attempted, and that if a piece cannot be finished at a red heat it must be completely reheated or finished cold."

Another point of very great importance in connection with the working of steel is the question of annealing, especially of such work as requires to be subjected to several heats. To elucidate this a series of experiments were made on welded beam knees of different sections, some being wholly annealed, some partially annealed, and some unannealed. They were all subjected to similar tests, "the knees being bent round flat on the beam and the end of the knee doubled in upon it." Very little difference was found between the different specimens, and accordingly such work is not now annealed.

In addition to these experiments on annealing others were undertaken to ascertain its effect on the tensile strength of plates, the results show that this process somewhat reduces the ultimate strength but increases the extension, its effect, however, being considerably more marked in thin than in thick plates.

Other experiments were made to ascertain the strength to resist shearing of steel rivets when used in steel plates, the result showing only a mean strength of 20 tons per square inch, smaller rivets, however, tested singly, gave a mean strength of 24½ tons per square inch.

A very complete set of experiments were also made to ascertain if there is any difference in the result of testing, carried out at varying rates of speed, these experiments showed conclusively that the effect of the time, taken in testing is practically nothing, either as regards the ultimate strength or the elongation under strain.

Mr. Denny's firm now make all their stems, stern frames, and rudders of scrap steel forgings; but before doing so made a set of experiments on the relative tenacity and rigidity of scrap steel and scrap iron, the mean results showing, in point of strength of 15·5 per cent., and in rigidity of from 50 to 33 per cent., in favour of steel.

The experiments recorded in this paper shew very conclusively the uniformity of the material. Its reliability in actual work was also very clearly shown by the results of accidents which have happened to two of the steamers built by this firm, which—by the permission of the owners—were given in the paper. In the first, a light draught steamer, the vessel struck on a snag in the Upper Irrawaddy, but came off safe and sound, the plating much indented but not broken. In the other case, an ocean going steamer ran on to and over a rock, very heavily indenting the plating and badly bending the frames, but without producing fracture. In each case, had the vessels been built of iron, there is no doubt that they would have sunk.

The superiority of steel over ordinary iron was further shown in the case of six light draught steamers, which were built of steel during last year; they were put together in the yard at Dumbarton, shipped to Glasgow in lighters, and transhipped on steamers to be sent out to the East, without having any accident through breakages, while, in the case of similar vessels of iron, built, and sent out in the same manner, the loss and delay through breakages were very annoying.

Mr. Denny, in his paper, advocated the use of steel of a higher tensile strength then that now in general use. Another paper read, after Mr. Denny's, and discussed along with it, by Mr. West, the principal Surveyor of the Liverpool Underwriters' Registry, also took the same view. Mr. West proposed the general adoption of a minimum limit of strength of 30 tons per square inch; but would not give any maximum limit, provided the material stood the test of ductility now in general use; viz., that pieces of the steel should stand bending to a curve, the inner radius of which is not greater than one-and-a half times the thickness of the plate, after having been heated to redness and cooled in water at a temperature of 82 degrees.

In the discussion which followed, the speakers seemed far from unanimously agreeing with this proposal. Dr. Siemens and Mr. *Riley, of the Steel Company* of Scotland, both deprecated any advance in the tensile strength of steel beyond the limits at present insisted upon by Lloyd's, viz., from 27 tons to 31 tons per square inch; whilst several of the shipbuilders present entirely agreed with it. In the opinion of Dr. Siemens the higher the tensile strength of the material the greater became the loss of strength from punching and working, and the greater also became the liability of its being injured through receiving a temper in being heated so that it did not at all follow that a stronger, and at the same time a more reliable ship would result from the use of a stronger material. It is to say the least, significant that these two gentlemen, so intimately connected with steel producing, should hold such strong opinions as to the undesirability of harder steel being used for such purpose as shipbuilding.

Altogether the paper is a valuable contribution to our knowledge of the properties of mild steel, the experience gained as to the best methods of working it, so freely given in the paper, cannot but be of great service to all interested in its use.

LONG'S PATENT ATMOSPHERIC UNSINKABLE STEAM LIFE BOAT.

WE have inspected a steam life boat now in course of construction at Messrs Halsey & Co.'s yard at Wandsworth, for the patentee, Mr. J. Long. The hull is of steel, and is provided with a double bottom, which again is divided into several air-tight compartments, each to be provided with an automatic emptying valve. In addition to these air-tight compartments there are seven circular drums or cylinders, built into the shell of the boat at each side; each one of these drums is distinct and separate from the remainder; in the whole there are twenty-two separate compartments.

The boat is 36 ft. long by 9·6 beam, and is a fair good model under water; the engines are a pair of condensing, capable of indicating 30 horse-power, and a speed of 10 miles is expected to be attained by the builders.

Judging from the many unsuccessful attempts on the part of life boats propelled by oars alone against a heavy sea and wind, we hail this departure from the established custom as a stride in the right direction, and we wish the undertaking success.

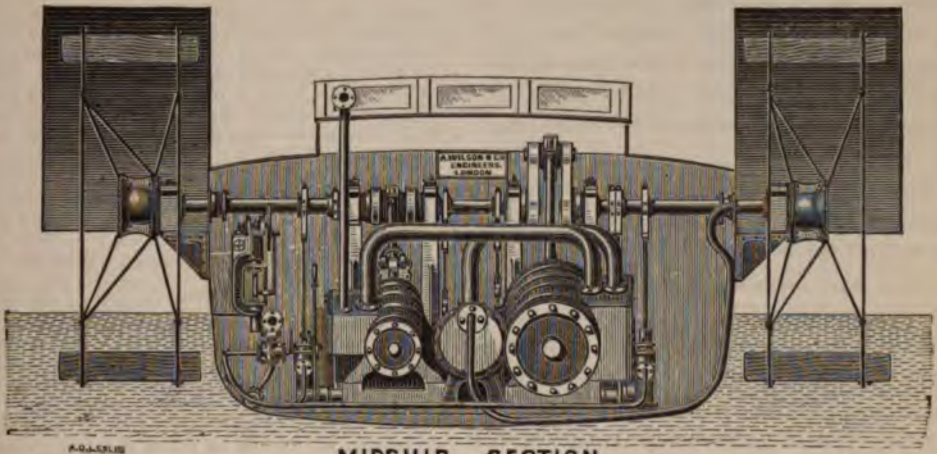
IT is stated a contract has just been secured by the Iron Shipbuilding Company, at Cowpen Quay, Blyth, to build a large iron screw steamer of 2,500 tons burthen for Messrs. Watts, Ward & Co.

THE boiler of the steamer Colomba, belonging to the Valery Company, bound for Algiers, burst in the harbour of Bona. The steamer was driven with great force towards the shore, and crashed into two Spanish feluccas, injuring very seriously 25 men who were on board of them. Two fireman belonging to the Colomba were killed by the explosion, and the chief engineer was so severely injured that his life is despaired of.

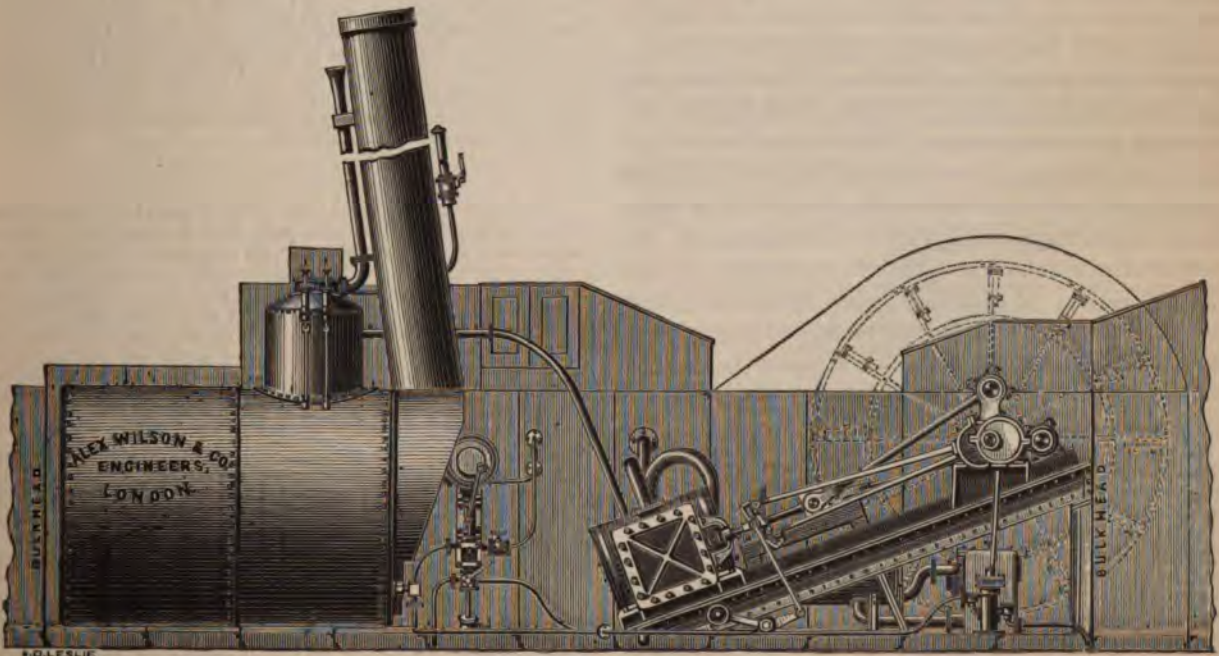
THE TOPOPHONE.—A new instrument, called by this name, has been experimented upon and described by Professor Morton in his report to the Lighthouse Board of the United States, by which the exact direction of sound given by fog-horns or fog-bells may be ascertained. The machinery is very simple, and consists of a vertical rod passing through the roof of the deck cabin, to the upper end of which are attached two adjustable resonators. Below these is a pointer, set at right angles to the bar, while rubber tubes pass through the cabin roof and are connected with a pair of ear tubes. The whole apparatus can be turned towards any direction, and the result is that any person sitting in the cabin, by turning round until the least sound was perceptible, would bring the pointer to within 10 degrees, or less than one point, of the direction. The experiments proved that it was easy to ascertain whence the sound came from a distance of four to six miles.

COMPOUND SURFACE CONDENSING PADDLE ENGINES.

DURING the last few years our readers will have observed that there has been a great development in small steamers for river, harbour, and pleasure purposes. One of the firms which has been most prominent in developing various types of engines for these small vessels has been Messrs. Alexander Wilson & Co., Vauxhall Iron Works, Wandsworth Road, S.W. We this month illustrate one of their recent applications of the compound surface condensing engine to a small paddle steamer for carrying passengers across a sheltered bay where the water is salt, and thus prohibits the use of a jet condensing or high pressure engine and where the depth of water necessitates a draught not exceeding 2′ 3″. As our readers are aware the introduction of the compound surface condensing engines into the mercantile marine has enabled steamers to compete successfully with sailing vessels in nearly every direction, the saving in the consumption of fuel making all the difference between profit and loss, and though it is erroneously supposed that compound surface condensing engines cost a great deal more for repairs than the old fashioned



MIDSHIP SECTION



LONGITUDINAL SECTION

COMPOUND SURFACE CONDENSING PADDLE ENGINE.

types, we think this is a mistake, if the machinery is made of good materials and has good workmanship put into it. A mistake that is too often made is to purchase a cheap engine which is designed with its crank shaft and other parts of sufficient size only to enable it to survive the trial trip, in smooth water, by a few months, and then when a break-down takes place the principle of the engine is blamed instead of the low price at which it is bought. There is, therefore, in our opinion, no reason why compound surface condensing engines should not be applied to the machinery of launches as well as to that of larger vessels, and we see that Messrs. Alexander Wilson & Co., are now making them down to a size having a cylinder as small as 6' dia. The engines we illustrate this month are perhaps the smallest compound surface condensing engines that have ever been fitted to a paddle steamer, the high pressure cylinder being only 9' dia., the working pressure being 100-lbs. per square inch. It will be seen that the engines are fixed on bed-plates attached to a framework built into the boat. The reversing is accomplished by link motion reversing gear and the piston and valve rods are of steel, of which also the crank paddle shaft and connecting rods may be made when great lightness is required. The air and circulating pumps are worked from the engine shaft by means of eccentrics, but Messrs. Alexander Wilson & Co., recommend that these pumps should be worked on their patent direct acting system quite independently of the main engines, as the latter are then much more easily handled, and the main engines not having the drag of the pumps upon them, but having only to turn the paddle wheels are capable of applying much greater power to the propulsion of the boat. This system they are now largely applying to their screw engines with the most satisfactory results. The surface condenser is made with a wrought iron casing for the sake of lightness and is fitted with brass tubes and gun metal tube plates, and is placed longitudinally between the two engines. The paddle wheels are made with fixed floats, as it is found in small vessels the advantage gained by feathering floats is lost by the friction of working them, and they are more difficult to keep in repair, which in some parts of the world is rather a serious consideration. The boiler is of the usual return tube type which is the most suitable for carrying high pressure of steam. The boat to which this engine was fitted was 88' 0" long, 11' 0" beam 2' 3' draught and was fitted with cabins, &c., to carry 160 passengers at a speed of 11 miles per hour, which is rather more than that obtained by the passenger boats plying above London Bridge, and the consumption of coal was only 1 cwt. per hour.

In a future number we purpose to notice some of the other specialities of Messrs. Wilson & Co., which will *interest our readers.*

H.M.S. NELSON.

THIS new ship, armour-plated, with double screw-propellers, is of 7,323 tons burden, with engines of 6,000 horse power, and carries twelve heavy guns. She was taken into Chatham Dockyard the beginning of the past month after a course of trials with her engines and machinery, under Staff-Commander James R. Osborn, and is to be fitted for being placed in commission. Like the Northampton, the Nelson is an improved Shannon, and is designed to cruise either under steam or sail, or both combined. She measures 280 feet in length and 60 feet in beam, and has a displacement of 7,323 tons. Only the central part of the ship, which is 180 feet of the whole length, is armoured, the protection extending from 5 feet below the water-line to the shot-proof main-deck (which is 4 feet above the water), and tapering from 9 inches to 7 inches in thickness. An important peculiarity in the ships of this type is that the steering-gear and tillers are well under water below the armour-deck, thereby securing an efficient protection to a vital part. The machinery of the Nelson consists of a pair of compound vertical engines, designed by Mr. A. C. Kirk, and manufactured by Messrs. Elder & Co., of Glasgow, by whom also the ship was constructed. Each engine has two cylinders, a high-pressure cylinder 60 in. in diameter, and a low-pressure cylinder having a diameter of 104 in., with a 3 ft. 6 in. stroke. Instead of being driven by a rocking-beam off the piston-rod head, as usual, the air-pumps are worked by an eccentric on the main shaft, which also drives the feed-pumps. The engines are of new and peculiar design, but in their general arrangement follow the most recent Navy plans—two pairs of engines, one driving the port and the other the starboard propeller, with the boilers ten in number, placed back to back, the firing being performed athwartship from the wings. The machinery space is subdivided into six separate water-tight compartments. There is a midship fore-and-aft bulkhead dividing the engine-room into two, and the boiler space into four, as it is further crossed in the middle of its length by a transverse bulkhead. The ship is provided with the usual complement of fire-engines, donkey-engines, steering-engine, and ash-hoisting engines, and a complete arrangement of stop-valves is fitted which enables them to be worked from the deck. In the event of any of the six machine compartments being flooded with water, not only can the steam be cut off from the particular compartment, but it can be taken past it without the pipes being exposed to the action of the cold water, which would otherwise condense the steam. The machinery of the Nelson cost, according to the Navy Estimates for last year, £33,530. Tke two propellers are of the Mangin type, which would offer less resistance when the ship was under sail than the ordinary four-bladed Griffith. Each propeller has a diameter of 17 ft. 10 in., and a mean pitch of 19 ft. 6⅝ in. In the trial-trips, the full speed was fourteen knots an hour, with 82 revolutions of the engines per minute; the indicated horse-power was 6624. With only one of the engines going, a speed of ten and a half knots was obtained.

ICEFIELDS IN THE ATLANTIC.—The Warren Line steamer Iowa, arrived in the Mersey, March 24th, from Boston, with a portion of her bows stove in by collision with an iceberg. She reports that on the 15th and 16th inst., she fell in with continuous large fields and immense masses of floating ice and bergs extending from lat. 44 44 N., long. 53 43 W. to lat. 45 18 N., long. 48 25 W., and being no less than 225 miles on nearly an east line from where they were first met with. The ice extended north and south as far as could be seen, and from 100 to 200 distinct icebergs were observed. This almost unprecedented accumulation of ice in the Atlantic will add greatly to the ordinary risks of navigation.

THE ELECTRIC LIGHT IN THE NAVY.—The Superb, 16, 8760 tons, 743,0 horse-power, completing for sea at ChathamD ockyard, has been fitted with the electric light apparatus, and experiments will be made with the electric light apparatus during the ensuing week. The same firm are fitting the apparatus on board the Swiftsure, 14, 6660 tons, 4,913 horse-power, at Devonport; and the Thunderer, 4, 9387 tons, 6,270 horse-power, at Malta.

THE Lords Commissioners of the Admiralty have accepted the tender of the Patent Anhydrous Leather Company, for the mill bands of belts, double and single, all widths, for the Portsmouth, Devonport, and Pembroke dockyards, and for all the five naval yards for leather hand-loops. This is the third year in succession in which the Patent Anhydrous Leather Company's tenders have been accepted.

ON SIMPLE AND COMPOUND ENGINES.

ALTHOUGH the compound engine has almost universally superseded the simple engine for marine purposes on account of its superior economy, a reference to our "Correspondence" column will show that the principles whereby this economy is effected are not so well understood by some engineers as they should be, and a few remarks on this subject might therefore not be considered out of place. As we have stated in a previous number there are other considerations besides economy of fuel which have tended to the introduction of this system, and these we intend to notice in a future article.

In order to help us more clearly to understand the subject it will be well if we first state a few of the facts respecting the properties of steam, which have been deduced by careful experiments.

In order to produce steam from water heat must be applied to it. At first the effect of the application of heat is to cause the temperature of the water to be increased up to a certain temperature at which ebullition commences; after this the further application of heat produces the evaporation of the water, the amount evaporated being proportional to the heat applied, while at the same time the temperature both of the water and the steam which is formed remains constant. The temperature at which ebullition commences depends entirely upon the pressure. At the ordinary atmospheric pressure the temperature is 212 deg. at a pressure of 5 lbs. per square inch absolute, or 10 lbs. below the atmospheric pressure the temperature is only 163 deg., while at a pressure of 60 lbs. above the atmosphere the temperature is 307 deg., and at a pressure of 120 lbs. above the atmosphere the temperature is 350 deg. It will thus be seen that the temperature increases with, but at a much less rate than, the pressure.

The amount of heat necessary to convert water into steam, usually called the latent heat of steam, has been determined with great accuracy. At the pressure of the atmosphere it is equivalent to 5 36 times the amount necessary to raise the water from 32 deg. to 212 deg., or in other words it is equal to that which would be expended in raising 966 times the weight of water through one degree of temperature. At higher temperatures the latent heat is less, but with different pressures the sum of the latent and sensible heats is nearly constant, but increases slightly with the pressure. At a pressure of 120 lbs. per square inch above the atmosphere the amount of heat necessary to raise and evaporate the water from 32 deg. is only 4 per cent. greater than at atmospheric pressure.

The latent heat of steam is again made sensible by condensation. If heat is abstracted from steam a portion of it condenses, forming water, the proportion varying exactly as the heat abstracted. Further experiments have shown that pure steam very rapidly, in fact almost instantaneously, accommodates itself in temperature to metallic surfaces in contact with it which are kept at a lower temperature than that of the steam initially, so that its pressure almost immediately falls to that due to the temperature of the metallic surface, condensation taking place upon the surface. The admixture of a small quantity of air with the steam does not affect the final result, but retards in a very marked manner the speed at which condensation and the consequent reduction of pressure takes place.

Now in any steam engine, whether simple or compound, if it were possible to admit the steam into the cylinders without any reduction of pressure by wire drawing, friction of ports, &c., and to expand it down to the terminal pressure, doing work during the whole period of admission and expansion, the cylinders, pistons, &c., neither giving heat to or abstracting heat from the steam during any portion of the stroke, and on the completion of the stroke the steam was exhausted into the condenser, the amount of work the steam would perform would be dependent upon the initial pressure, the rate of expansion and the back pressure in the condenser, and would be altogether independent of the number of cylinders in which the expansion took place; and, further, if the work done by the steam was transmitted directly to the engine without any loss by friction of mechanism, it would be immaterial in point of economy whether simple or compound engines were employed.

But in point of fact the actual processes of the production of work in the steam engine falls short of these conditions in every way. 1. During the admission of steam into the cylinder the clearance, &c., has to be filled with steam without doing any work, and 2, a loss of pressure is experienced by the friction and wire drawing of the steam, especially when the valve is closing near the point of cut off. 3. The cylinders, pistons, &c., must necessarily be made of metal which is an excellent conductor of heat, and which gives heat to or abstracts heat from the steam according as its temperature is above or below that of the steam, and 4, there is necessarily work lost by the friction of the moving parts in all steam engines. It is according to the influences which these imperfections of the mechanism have in the different systems that their relative efficiency depends. These influences again depend largely upon the pressure of the steam, the ratio of the expansion, and the proportion of the cylinders in the compound engine, so much so that by an unsuitable design of compound engine for the pressure of steam and rate of expansion employed it is possible to make the engine very much less efficient than a simple engine.

As an illustration of this we might point out some of the early compound engines, working with a steam pressure of less than 30 lbs. per square inch, and giving results less satisfactory than with simple engines working at the same pressure; in fact it is only when high pressures and a large amount of expansion is used that the compound engine becomes more economical than a simple engine working under the same conditions, and this because under these conditions some of the imperfections, which, as we have seen, are common to both engines, become of so much moment in the simple engine, as to more than counterbalance the advantage it has in respect to some of the other imperfections of process over the compound engine.

With regard to the effect of the clearance spaces, to which, of course, must be added the capacity of the steam ports, it is to be noticed that if it were possible to construct a cylinder without any clearance, by using the same amount of steam per stroke, we should obtain an increased amount of work from it during the period that the steam is being admitted, in the proportion that the amount of steam in the clearance space bears to the total amount of steam admitted into the cylinder per stroke, but that during the expansion practically the same amount of work is got out of the steam, whether there is any clearance or not. It thus follows that where a high rate of expansion is carried out in *any* cylinder the effect of clearance is considerable, and is much greater in proportion to the rate of expansion. Now with a given rate of total expansion that portion carried out in the high pressure cylinder of a compound engine bears the same proportion to the total expansion as the ratio of cylinders, and consequently the loss from this cause is much less with the compound than with the simple engine. As an example let us suppose that the ratio of cylinders are three to one in a compound engine, the total ratio of expansion is 6, and the clearance spaces in the cylinders are $\frac{1}{12}$ of the total capacity. In the compound engine the steam would be cut off at about half stroke in each cylinder, the ratio of the clearance to volume of steam at cut off in each cylinder would be as 1 to 6, while in the simple engine the steam would have to be cut off at $\frac{1}{12}$ of the stroke (with the $\frac{1}{12}$ clearance making the total expansion 6), and the ratio will therefore be as 1 to 2. The comparison of these ratios shew that as ordinarily designed the effect of clearance is much more prejudicial to simple engines than to compound, while by using steam of a higher pressure, which will admit of a greater ratio of expansion being profitably used, the difference will tend still more in favour of the compound engine. It need hardly be remarked that one of the great advantages of long stroke engines over those of short stroke and same piston speed is due to the comparatively less effect of a given amount of clearance.

The next question, viz., loss of pressure, due to friction and wiredrawing of steam, tells altogether against the compound system. In the simple engine the steam has to be admitted into the cylinder once, and has to be exhausted from it once. During the whole of the expansion, it is exerting a pressure against the piston and is doing useful work. In the compound engine, the steam is admitted into the high-pressure cylinder and exhausted from the low-pressure cylinder into the condenser under nearly similar conditions as in the simple engine; and the loss by wiredrawing, resistance of passages, &c., might fairly be taken as nearly identical in the two cases, but, in addition, the steam has to be exhausted from the high-pressure cylinder into the receiver, and admitted from the receiver into the low-pressure cylinder, often through intricate passages. A measure of the loss occasioned by this is the difference between the back pressure in the high-pressure cylinder, and the forward pressure in the low-pressure cylinder during the period steam is being admitted into it. In the best constructed engines this is seldom less than 3 lbs. per square inch, whilst in very many it is 5 or 6 lbs., and sometimes even more. There is a further loss in some engines, due to the fact that the terminal pressure in the high-pressure cylinder is greater than the pressure in the receiver, and consequently some power is lost by the steam falling in pressure as it enters the receiver, without at the same time performing work.

The most important of the imperfections we have noticed is number 3, the effect of the metal of the cylinder and piston upon the temperature of the steam. Bearing in mind the fact before mentioned that steam almost instantaneously condenses on metallic surfaces of lower temperature which are exposed to it, and that the mass of the metal composing the cylinder and piston is enormously greater than that of the quantity of steam contained in the cylinder at any given instant, it is easy to see that its influence must be very great.

If originally dry steam is expanded, doing work without gaining or losing heat from external sources, as its pressure decreases its temperature falls, and a portion of it becomes condensed, (part of the heat in the steam is converted into work). If during the expansion heat is abstracted from the steam, a greater portion of it will become condensed, and its temperature and pressure will be lower than it was before; while if heat be added to the steam during expansion, less of it will become condensed, or possibly none of it may be condensed, and it may become superheated according to the amount of heat added. In an actual cylinder the temperature of the metal will always be intermediate between that of the steam as it comes into the cylinder and as it leaves the cylinder. During the admission of the steam, the cylinder sides being colder than the steam causes condensation to take place, the latent heat of the steam passing into the metal and raising its temperature, so that by the time the ports are closed more steam has entered the cylinder than the volume of the cylinder open to it, during the early portion of the expansion also, as long as the temperature of the steam is greater than that of the surfaces of the cylinder exposed to it, condensation takes place, and the pressure and temperature of the steam consequently rapidly falls. At a certain point of the expansion the temperature of the steam will have fallen to that of the cylinder, and as the expansion still continues the temperature will fall still lower. During this portion of the stroke the cylinder, being hotter than the steam, and it having water deposited upon it from the previous condensation of the steam, a portion of the water evaporates, taking its latent heat of evaporation from the cylinder, which it consequently cools. During the return stroke, when the cylinder is open to the condenser or receiver, as the case may be, the pressure of the steam in it being much lower than that due to the temperature of the cylinder, the remainder of the water, which was condensed, rapidly boils off, and, of course, abstracts its heat from the cylinder and passes into the condenser or receiver. We thus see that during the first portion of the stroke the cylinder is condensing the steam and abstracting heat from it, while, during the latter portion of the stroke, and during the return stroke, it is giving up heat to the steam. This transfer of heat, to and from the cylinder, is under certain conditions very great, and it is always a very great source of loss of power; during a small part of the forward stroke it is true that the pressure becomes increased, but, during the first part of the stroke, the reduction of pressure is very serious, whilst for the whole of the return stroke the effect is an expenditure of heat producing a back pressure. This transfer of heat—other things being the same in the two cases—is evidently greater the greater the extremes of temperature between which the steam works, and, as we noticed above, a difference of temperature has a greater proportionate effect upon steam at a high than at a low pressure.* The amount of condensation taking place in a simple engine will, therefore, be very considerably greater than that in a compound engine, during the admission of the steam, owing to the cylinder in the former being exposed to the low temperature of the condenser during the whole of the exhaust, while the high pressure of cylinder is only exposed to the comparatively higher temperature of the receiver, and the cylinder in the simple engine has also a much greater surface on which condensation can take place. During the exhaust into the condenser also the boiling off of the condensed water, and consequent transfer of heat into the condenser must be more rapid than in the case of the low pressure cylinder of the compound engine which is not exposed to nearly so high a temperature as that due to the initial steam pressure. It is true that condensation takes place to a small degree in the low pressure cylinder under some conditions, but when this cylinder is steam jacketed the condensation is very little, if any. Altogether it may be said that the marked economy of the compound engine over the simple engine is due principally to the fact that the cylinder surfaces are not exposed to so great a range of temperature, and that consequently so much heat is not radiated wastefully into the condenser; the loss from this cause in the simple engine far more than counter-balancing the loss which is inevitable in the compound engine from the passage of the steam from one cylinder into the other.

The fourth cause of loss of efficiency of steam engines mentioned above, in its comparative effect on the two classes of engines is intimately connected with other questions than economy which have affected the substitution of the compound engine for the simple engine for marine purposes, and had better be left for a future article.

(*To be continued.*)

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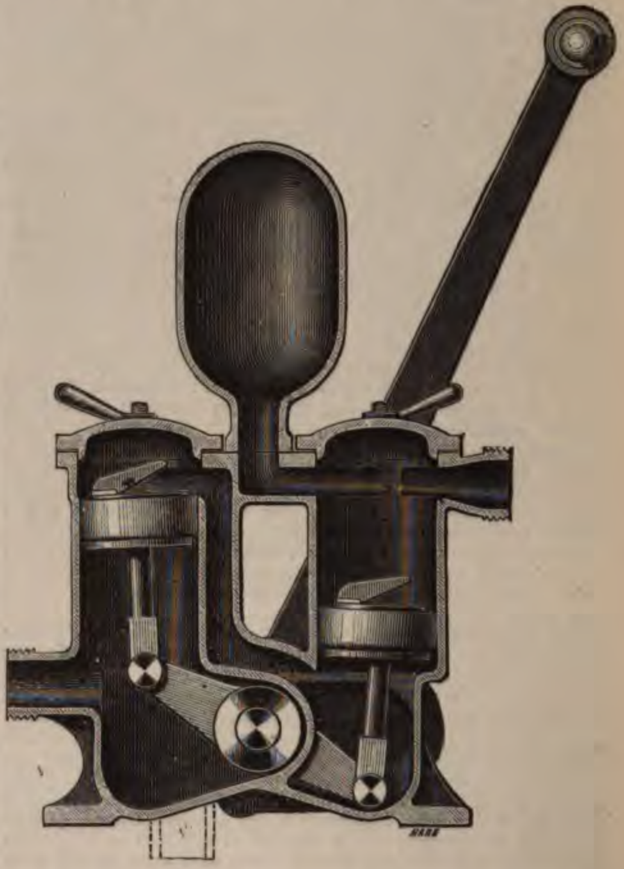
* At 120 lbs. pressure above the atmosphere 1 deg. makes a difference of 1¼ lbs. per square inch pressure; at 60 lbs. 1 deg. makes a difference of 1 lb.; at atmospheric pressure of ¼ lb., while at 10 lbs. below the atmosphere 1 deg. *makes only* a difference of ⅛ lb. per square inch.

AMOS & SMITH'S PATENT PUMP.

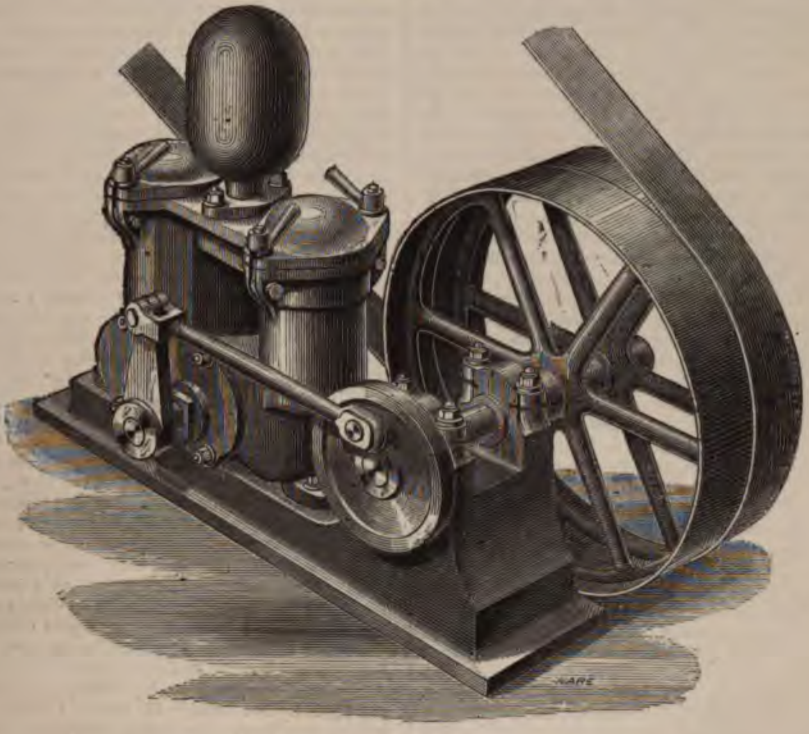
THERE are few things that engineers have spent more time and thought upon than pumps, and their efficiency; durability, simplicity, and easy access for repairs, clearing the valves, or examination, have generally been the objects sought after. We think that the pump illustrated in the accompanying woodcuts seems to meet these desirable requirements in a very complete manner. Its construction and action will be understood from the section; it will be seen that there are two buckets, each with a valve on the top. They have alternate up and down strokes communicated to them by the working shaft, which is driven by a hand-lever, as shown in the smaller pump; by belt as in the larger one, by an engine fixed on the same bed-plate, or other suitable means. When the right-hand bucket rises it forces the water in front of it, and draws through the



valve in the left-hand bucket by the communicating passage shown. When the left one rises it forces the water through the valve in the right-hand bucket. The pump is thus double-acting, both on the suction and delivery side, with only two valves, which are in turn suction and discharge valves for each other. There is a cover above each bucket and valve, the joint of which is made tight by a thick rubber ring, which will, of course, last for a considerable length of time. It is screwed up by turn-down bolts with hand-screws, so that it can be removed, the valve or bucket examined or cleared; and the joint re-made in a very short time.

We have seen a number of these pumps of various sizes under construction, as well as at work, and can speak to the substantial manner in which they are made and their satisfactory working results. One of them was fixed as a fire-engine, and, when worked by four men, threw a good, solid, continuous jet. Messrs. Amos & Smith also informed us that they have recently fixed a large one on board the ss. *Marengo* which vessel is in the regular Atlantic trade. It is driven by slow or fast gearing by a separate engine, the slow speed being used for pumping against pressure as a fire-engine, and the quick speed for circulating, pumping out the ballast, or from the bilge in case of serious leakage or inrush of water from any other cause.

They are manufactured by Messrs. Amos & Smith, Engineers, Hull, who are the patentees.



THE INSTITUTION OF NAVAL ARCHITECTS.

THIS institution commenced its annual meetings on March 17th, in the Hall of the Society of Arts, John Street, Adelphi. After the report, which showed that the affairs of the society were prosperous, had been read, the election of office bearers was proceeded with, and 23 new members were elected. The president, Lord Hampton, who has held office for 21 years, retired, and the Earl of Ravensworth was unanimously chosen to take his place. In accepting the appointment, he expressed his high sense of the honour which had been done to him, and referred to the valuable services of the institution in bringing to bear on a great national industry all the talent the nation can command and in assisting the Admiralty with their combined experience. Lord Hampton, in his address, said thay would have most implicit confidence in the abilities and competence of his successor. He alluded to the explosion of the large gun on board the Thunderer, remarking that it had formed a subject of discussion at their last meeting, and it was satisfactory now to find that their conclusions at that time that breech-loading guns were best suited for naval purposes were about to be acted on by the Admiralty. Afterwards he drew attention to the use of steel for facing armour plates and for other purposes in ship-building, and he commended the proposal to employ mercantile vessels in time of war as cruisers. A paper was then read by Mr. B. Martell, chief surveyor of Lloyd's Register of Shipping, on "Causes of Unseaworthiness in Merchant Steamers." The first obvious cause was structural weakness, but from his experience, he said, he could deny that recent losses were due to this source of unseaworthiness. Deterioration of materials in the structures led to loss, but this danger was rapidly diminishing through the practice of cementing the insides of iron ships. The arrangements for the security of the sea-cocks and for pumping facilities were now much improved, but still required attention. Adverting to careless navigation, Mr. Martell considered that the officers of the mercantile marine have considerably improved of late years. He proceeded to describe the different types of merchant steamers, and analysed the stability of each.

Full, flat-bottomed steamers with small poops had little stability, while large-pooped and spar-deck vessels had very great stability. All vessels, however, could be trimmed to have ample stability, and he showed how in one steamer, by replacing 80 tons of cargo with 80 tons of water ballast, the curve of stability was increased from 52 deg. to 75 deg. No danger was to be feared from water ballast tanks, provided they were suitably arranged and formed in regard to the design of the ship. It was to be regretted that the system of tonnage dues disproportionately taxed spar-decked steamers, and this system frequently prevented the enclosing of the space at the sides of the engine-house—an additional means of safety of great value. Speaking of cargoes carried in bulk, this was, he said, mainly a matter of stowage. Not a single grain-laden vessel from Montreal had foundered at sea since the Port Warden there had been invested with powers to insure compliance with his regulations. Various means of stowing grain were alluded to. An opinion was expressed that deficient stability would not be cured by carrying the entire cargo in bags. Recent losses would not have been obviated by carrying the cargoes in bags, and a cargo partly in bulk and partly in bags was, he believed, perfectly safe. In the discussion which followed Mr. Merrifield, F.R.S., deprecated the common running of steamers with too small margins of stability. Sufficient money, he considered, was not spent in obtaining calculations of the stability of merchant ships. Mr. J. Scott Russell, F.R.S., objected to double bottoms, holding them to be a great source of danger. He commended longitudinal central bulkheads, urging that no serious objections could be brought against them. Admiral Sir Spencer Robinson thought that water ballast contributed to the stability of a ship, and this, he said, was the opinion of every one with whom he had spoken. It was stated by other speakers that water ballast tanks fitted in the holds of vessels had been tried, but, the ballast being higher up, more water had to be carried, and the excessive quantity was in danger of breaking adrift. Ships were often lost when they had strange captains, and one instance was mentioned of a captain who at three different times when he remained at home had his vessel lost by the strangers in his place. The discussion closed with a vote of thanks to the reader of the paper.

On the Thursday Mr. N. Barnaby, C.B., Director of Naval Construction to the Admiralty, read a short paper on "The Nelson Class." Referring to the different speeds developed by the twin ships Nelson and Northampton, he said he hoped to give full explanations next session, after further trials had been made. Comparing these vessels with the Bellerophon, he claimed that they were both better armed and better protected, and their coal capacity was greatly superior. Admiral Sir Spencer Robinson complimented the designer of the type, asserting that no war ships belonging to other Powers were able to carry so much coal. It was his opinion, however, that under sail they would not be of much service seeing they carried two screws. He closed his remarks by deeply lamenting the slow speed of our smaller class of ironclads. Mr. A. C. Kirk, of the firm which built the Northampton and who designed the Nelson's engines, considered that the lesser speed of the Northampton was due to the different position of her propellors and the non-compounding of her engines. It was pointed out by Mr. J. Scott Russell, F.R.S., that the Nelson had eight unprotected guns in addition to four protected, which would be of the greatest advantage in delivering a broadside at close quarters. These could be fired by electricity, but he did not think our seamen would skulk behind the armour should they be required to work the unarmoured guns. Mr. Russell then read a paper on "The True Nature of the Resistance of Armour to Shot," in which he described, in an elaborate manner, the additional strength gained by covering iron plates with steel. He recommended that the armour of existing ships should be overlaid with a coating of steel in place of entirely replating the vessels. He advised also that armour plates should be on the inside skin of a ship instead of on the outside. By this means the plating would not be displaced when split or even when broken into fragments and the injured armour could be replaced without inconvenience. A passage on guns in the paper stated that in guns built up of cylindric rings the wave of force occurring on a shot being fired met with a violent shock at every meeting place of the rings. One part of the shock was sent forward and one part backwards, and Mr. Russell stated that he had seen the entire rear of a naval gun thus constructed blown to a great distance, and he had also seen the fore part of another naval gun fired forward in the same direction as the shot, just as if the barrel had itself been shot. In the discussion which followed, the necessity of the equable tempering of steel-faced iron plates was insisted upon. A paper was read by Mr. A. C. Kirk, M.I.C.E., in which he described a method he uses for analyzing *the forms of ships* and determining the lengths and angles of entrance. Mr. J. Normand read a paper, the result of which was to show that the differences in the performances of different screws tried on Her Majesty's ship Iris were probably due to an insufficient estimate of the direct resistance of the blades. At the evening sitting a paper, written by Mr. John R. Ravenhill, was read, which gave a history of the passenger steamers, on the passage between London and Gravesend. It stated that the Thames was the nursery from which emanated the light draft vessels first employed on the Rhine, the Seine, the Danube and other European rivers, the Nile and Indian Rivers; they were also the pioneers of the packets employed in the Channel and the Holyhead mail service. Several speakers extolled the London river steamers, but Mr. Martell considered they were a great disgrace to this country, and asked why they were not equal to those on the Mersey and Clyde. Mr. Dixon Kemp read a paper on "The Stability of Yachts." He compared three types of yachts, and showed that depth rather than beam insured the highest stability at excessive angles of inclination. In a sea-way depth also gave the most easy motion. A paper on "A Wave Line Form of Midship Section," by Mr. J. Scott Russell, concluded the meeting.

At the meeting on Friday, Mr. W. John, surveyor at Lloyd's, read a paper on "Cellular Construction of Merchant Ships." The longitudinal system of building steamers came prominently into notice when the Great Eastern was built, but afterwards was only employed in constructing ironclads. Of late, however, it has come into use for ships of the mercantile marine, over 100 steamers being built or are building, on this system at this time. The paper described various modifications of the longitudinal principle. Mr. J. Scott Russell, F.R.S., explained that he objected to double bottoms only when the cells were too small for the painter having access—in that case they ruined the ship. The Great Eastern's double bottom only extended over her flat floor, not at the stem and stern where the floor began to rise. He had been through every one of her cells; indeed in their early days he never built a boiler or a condenser without going personally through every part of it. When ships were built longitudinally, if the cells were small the tops should be left open, as was the case in his Annetee. He congratulated Lloyd's on coming forward and advocating a new principle. For 20 years they refused to register ships which he had built on this principle, although they were insured as if registered. A paper was read by Mr. William Denny which related the experiences of his firm in building steel ships. The failures in manipulating the metal were not serious, and had chiefly arisen from the men working it at a black heat. Instructions had been issued that this was not to be attempted, and now the flaws in steel were less in number than the flaws in iron. The results of various tests of the strength were detailed, and Mr. Denny was not altogether satisfied with them. Only very mild steel had been used, and he thought that a higher tensile strength might safely be employed, particularly for the framing and inner plating. The scrap had been most successfully worked for the heavy forgings, and one of their steamers had both piston-rods made from scrap steel. They had no experience of steel being more corrosive than iron. As yet they were not able to obtain regular delivery of steel, and Lloyd's rule of testing at the yard was a source of great annoyance and expense. A paper describing the regulations of the Admiralty, Lloyd's, and the Underwriters' Registry relating to the strengths of steel used in shipbuilding, and suggesting modifications was read by Mr. Henry H. West, Chief Surveyor to the Underwriters' Registry. Discussing these papers, Mr. Bramwell approved of Mr. West's suggestion that *maximum* tests should be abandoned bending and *minimum* tests being in his opinion sufficient. Several reasons in favour of mild steel were stated by Dr. Siemens; and Mr. Martell, of Lloyd's, stated that Lloyd's regulations had been drawn up under exactly the considerations Dr. Siemens had brought forward. Mr. Kirk complained that Lloyd's testing plates at the yard was very irritating, and he highly commended the metal for shipbuilding purposes. He approved of the suggestion to work with less mild steels, thinking the tension scale might well be extended from 30 to 40 tons per square inch. Tests with German steel were described by Dr. Parker, and he said that, while it stood all the mechanical tests, it cracked when heated. Investigating the cause of this, it was found the makers had not cut off the bad material round the edges, not knowing what boiler plates (the steel being intended for this purpose) had to stand. In the centre the plates were of admirable quality. Dr. Parker also stated that steel boilers did not corrode more than iron boilers. Mr. Riley, of the Steel Company of Scotland, deprecated abandoning the present standards of tests, considering it would be an abandonment of security. The high regard in which steel was held was greatly owing to the careful tests of the manufacturers, and these should be rigorously maintained. After some further discussion the meeting adjourned, taking a paper on "The Relation between the true period of Waves and the Period as observed on Board a Vessel," by Mr. Emil Bertin, as read. The evening sitting commenced with a paper by Mr. J. Mac Farlane Gray explaining a simplification of thermodynamics of steam. Mr. J. F. Flannery read a paper descriptive of recent experiments in artificial combustion. These were made for the purpose of discovering some mode of burning anthracite coal on board steamers. Owing to its slow combustion and property of disintegrating and falling through the fire-bars, this coal has hitherto been unsuited for use on board ship. By fitting hollow perforated bars, through which a fan blast was sent, and placing the bars close together, these drawbacks have been overcome, and the results are most economical. The bars do not sustain injury, the passage of the blast through them keeping them cool under a very intense fire. Amsler-Laffon's mechanical integrator was described in a paper by Mr. C. W. Merrifield, F.R.S. The object of this instrument is to find the area, the statical moment, and the moment of inertia of any closed curve by simply tracing out the curve with a pointer, the machine doing all the rest, and the results being read off directly from it without any trouble of calculation. The session of the institution was brought to a close by the presentation of an illuminated address to the president, Lord Hampton, on his retirement from the office, which he has held for 21 years.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Silvio.—On the 9th March there was launched from the yard of Earles' Shipbuilding and Engineering Company, (Limited), Hull, a new steamer for Messrs. Thomas Wilson, Sons & Co., which was named Silvio by Miss Newbald, daughter of Mr. C. Newbald, of Messrs. Wilson's. The vessel was then placed in the company's tidal dock, where she will have her engines put on board and be generally fitted out. The Silvio is intended for the Baltic trade, and is 240 feet long between perpendiculars 32 feet beam, and 17 feet depth of hold, and 1,180 tons gross register. She is built to the rules of the Liverpool Underwriters' Registry for the highest class, and has a raised quarter-deck aft, a bridge amidships, and a full forecastle. She will be propelled by a single crank compound engine of 120 nominal horse power, the cylinders being 24½-inch and 53-inch diameter, and 36-inch stroke. Steam will be supplied from one very large steam boiler, and there is in addition a powerful donkey-boiler for the winches, &c., but which may also be used to supply steam to the main engines.

Skyro.—On the 13th March there was launched from the shipbuilding-yard of Mr. James Laing, Deptford, an iron-screw steamer of the following dimensions, viz:—Length (extreme) 235 ft., breadth 32 ft., depth 16 ft., and having a carrying capacity of 1,530 tons. Engines of 115-horse power, by Mr. George Clark, of Southwick. The steamer is fitted with Emerson, Walker, and Co.'s patent windlass, three steam winches by Clarke, Chapman, and Gurney, Colling & Pinkney's patent topsails, large hatchways, water ballast, &c. This is the ninth vessel built by Mr. Laing to the order of Messrs. D. G. Pinkney & Son, and is especially adapted for the Baltic and ore trades. As the vessel left the ways she was christened the Skyro by Miss Kenyon, daughter of Henry Kenyon, Esq., of Maryport.

Benalla.—On the 13th March there was launched from the shipbuilding-yard of Messrs. W. H. Potter & Son, Liverpool, a steamer of about 1,600 tons built to the order of Mr. Joseph Hoult of that town. As the vessel left the ways she was christened the Benalla by Mrs. Hoult, wife of the managing owner. The Benalla is the second of four steamers which Messrs. Potter have on hand for the same owner. Messrs. John Jones & Sons will fit her up with machinery and boilers, after which she will be employed in the owner's Spanish and Demerara trades.

Tafna.—On the 13th March a spar-deck screw steamer was launched from the yard of Messrs. Schlesinger, Davis, & Co., at Wall's End. As the vessel left the ways the christening ceremony was performed by Madame Imbert-Gourbeyre, mother of the French Consul. The Tafna is to be fitted with powerful engines by Messrs. R. & W. Hawthorn, and is built for Mr. J. Mesnier, of Paris and Swansea.

Lily.—On the 13th March the steamer Lily was launched by Messrs, Laird Brothers, of Birkenhead. She is the second of the steel paddle-wheel steamers they are building to the orders of the London and North-Western Railway Company for their express passenger service between Holyhead and Dublin, and is identical in every respect with the Violet, launched four weeks since, These steamers are built entirely of steel, manufactured at the company's own works at Crewe, under the superintendence of Mr. F. W. Webb. They have a length over all of 310 feet, with 32 feet beam, and 14 feet depth of hold, and will be fitted with oscillating engines of Messrs. Laird's construction, capable of exerting upwards of 3,000 horse-power by indicator, and giving a speed of 17 knots. The Lily was christened by Miss Knowles.

Zingri.—On the 13 March there was launched from the shipbuilding-yard lately occupied by Mr. J. Stephens, shipbuilder, at Fowey, a schooner of about 140 tons burthen, A 1 12 years, purchased by Messrs. Sparrow, of Plymouth. On leavtng the yard she was named the Zingri by Mr. Sparrow. She is intended principally for the coasting trade, and to be commanded by Captain Hill, late of the Peter and John, in the same employ.

LAUNCHES.—SCOTCH.

Rio Branca.—On March 10th Messrs, Henry Murray & Co. launched from their yard at Greenock a paddle steamer called the Rio Branca, of the following dimensions:—Length, 225 ft.; breadth of beam, 27 ft. 9 in.; depth of hold 9 ft. This is almost a twin boat to the Rio Apa, which was launched by the same builders on the 12th May last, and has been constructed to the order of Mr. David Rowan, engineer, Glasgow. After the launch the Rio Branca was towed to Glasgow, where Mr. Rowan will supply her with a pair of compound vertical steeple surface condensing engines, with 40-in. and 66-in. cylinders, and a piston-stroke of 5 ft. 6 in. The new steamer is to be engaged, along with the Ria Apa, in river traffic at the Brazils.

Ravenna.—On the 12th March Messrs. William Denny & Brothers launched from their shipbuilding yard at Dumbarton another addition to the extensive fleet of the Peninsular and Oriental Steam Navigation Company. The ceremony of naming the vessel Ravenna was performed by Miss Jamieson, daughter of Captain Jamieson, superintendent of steamers building for the Peninsular and Oriental Company. The principal dimensions and particulars of this vessel are as follow:—Length between perpendiculars, 380 ft.; breadth, moulded, 40 ft.; depth moulded to upper deck, 28 ft.; full poop, bridge, and topgallant forecastle, straight stem and elliptical stern; gross tonnage about 3,300. The Ravenna is classed 100 A 1 under special survey, and is entirely built of steel, manufactured by the steel Company of Scotland, and submitted to Lloyd's tests before being used. In many respects she is much in excess of the requirements to the highest grade at Lloyds. She is constructed on the continuous cellular double-bottomed system, 3 ft. 6 in. deep, and capable of containing 485 tons of water ballast. First-class accommodation is provided for 81 passengers; on the upper deck aft are state rooms ranged along each side of the vessel for a length of 120 ft., the dining tables being run from end to end in the centre, allowing all the passengers to dine at once. The state-rooms are unusually large, and all the berths are 28 in. wide. The long poop deck affords an excellent promenade of 260 ft. in length, the whole width of the vessel. On the main deck, the magazine, lazarette, ice-house, cooling, bullion, baggage, and mail rooms are disposed in convenient positions; and forward accommodation is provided for 30 second-class passengers, as also servants' pursers' stores, and wine rooms, sail-room and Boatswain's stores, &c. The Ravenna is rigged as a three-masted schooner, all the masts are of iron, and the shrouds so arranged that the yards can be swung round square. The standing rigging is of charcoal wire, set up on dead-eyes. All running gear is of Manilla hemp. Lightning conductors are fitted to all the masts. The machinery will be supplied by Messrs. Denny & Co., and is constructed on the compound inverted surface-condensing type, of 3,500 horse power; high pressure cylinder, 54 inches diameter: low pressure ditto, 94 inches diameter; length of stroke, 60 inches; working pressure, 75 lbs. The starting gear used is Brown's patent. Steam is generated in six iron oval boilers, with 18 furnaces; donkey boiler for supplying steam to winches, &c., and donkey engine for pumping water-ballast tanks. The Ravenna will be ready for sea in two months.

James Wilkie.—On the 13 March, Messrs. Dobson and Charles launched from their shipbuilding-yard at Grangemouth, a screw steamer, built to the order of P. V. J. Wilkie, of Grangemouth. The ceremony of naming the vessel James Wilkie was performed by Mrs. Peter Wilkie, Parkville, Grangemouth. The dimensions of the vessel are as follow:—Length, 175 ft.; breadth, 26½ ft.; depth, 13½ ft.; tonnage, 700.

Argo.—On the 15th March Messrs. Barclay, Curle, & Co., launched from their yard, at Whiteinch, an iron sailing ship, of 1,500 tons register, built to Lloyd's highest class, under special survey. She is the property of Messrs. A. & J. H. Carmichael & Co., Greenock. Her dimensions are:—240 ft. in length, 38 ft. in breadth, and 23 ft. depth in hold. The vessel, on taking the water, received the name of Argo from Mrs. Thomas Rennie, of Maybole.

Willie Glen.—On the 15th March Messrs. Barr & Shearer, Ardrossan, launched from their building-yard a three-masted schooner of the following dimensions:—Length of keel, 96 ft.; depth of hold, 10 ft. 9 in.; breadth of beam, 22 ft. 3 in.; register tonnage, 140 tons; gross burthen, 260 tons. The vessel is named the Willie Glen, of Glasgow, and she is owned by Messrs. Glen & Robertson, and is intended for the Newfoundland trade.

TRIAL TRIPS.

The Glenwilliam.—On the 6th March the new steamer Glenwilliam, 500 tons, built by Messrs. H. M'Intyre & Co., Paisley, and engined by Messrs. Hutson & Corbett, Glasgow, went down the Clyde to adjust compasses and run her trial trip, which was made in the Gareloch. The day was very boisterous, but, notwithstanding she made 12 knots, her engines working smoothly. The trial proving satisfactory, the vessel returned to the harbour in the evening, where she is taking in a cargo of coals. She is intended for the iron ore carrying trade between Bilbao, Barrow and other ports.

The Muriel.—On March 10, there proceeded to sea from the shipyard of Messrs Raylton, Dixon & Co., Middlesbrough, the Muriel (s), which has been built to the order of Messrs. Raynor & Murray of that town. She is 250 feet long by 33 feet broad, and 17 feet 9 inches in depth of hold, is 1,387 tons gross register, and will carry 1,900 tons of cargo on a draught of 17 feet 6 inches. She is built on raised quarter deck principle, and furnished with double bottom both fore and aft for water ballast, has iron masts and plate iron decks, and large hatchways, four steam winches, and every convenience for the rapid loading and discharging of cargo. The cabins for the accommodation of captain, officers, and engineers are placed amidships under the bridge, and there are two spare cabins for the accommodation of occasional passengers. Her engines are 120 horse power, are of the highest class of make by Messrs. Thomas Richardson & Sons, of Hartlepool. At the trial the working of the ship was eminently satisfactory, a speed of 11 knots having been made. She afterwards proceeded to the docks to load bridge material for the Afghan railways, discharging at Kurrachee.

Beryl.—On March 13th, the iron screw steamer Beryl, built by Messrs. M. Pearse & Co., at Stockton-on-Tees, had her trial trip, and was delivered over to her owner. She is a schooner-rigged iron screw-steamer, 240 feet in length over all, by 32 feet beam, and about 17 feet depth of hold, and has a full poop. Her gross tonage is 1,345 tons, and 567 tons nett register tonnage, with a carrying capacity of fully 1,700 tons. With a view to prevent cargo shifting, the steamer has double stanchions for shifting boards, and has the latter fitted in the holds. For water ballast there is a tank in the after part of the vessel. For the speedy discharge and loading of cargo the ship has every facility in the shape of four steam winches and all necessary appliances. Messrs. Blair & Co., (Limited), Stockton, are the builders of the steamer's engines, which are on the compound surface condensing principle of 110 horse-power nominal, having a reply telegraphic communication between the engine room and the bridge. The Beryl is the second vessel built by Messrs. M. Pearse & Co., for the same firm of owners at Hull, being intended for the Mediterranean and Baltic trades. Being slipped from her moorings at the yard early in the morning, she proceeded under easy steam into the Tees Bay, Shortly after 7 o'clock her head was turned towards the Tyne from off Hartlepool Heugh, and in a steady run, the engines making 80 revolutions per minute, she travelled the distance to Tynemouth Castle (over 21 miles) in about an hour and 55 minutes, the log registering 11 knots per hour. The compasses being adjusted off the Tyne, the steamer afterwards entered the Tyne Docks to load cargo for Genoa.

Gloamin.—At Dundee, on March 18th, the screw steamer Gloamin, built and engined by Mr. W. B. Thompson, for Messrs. R. A. Mudie & Sons, proceeded down the river to test the efficiency of her engines. She made a most satisfactory run as far as the Bell Rock, after rounding, which she returned to the river to test her speed at the measured mile. Very satisfactory results were attained, the speed being 12·287 with flood-tide, and 10·434 knots against it, giving an average speed of 11·360 knots, with 80 lbs. pressure on the boiler. The engine worked very smoothly. A select party was entertained to dinner by the owners while the steamer was on her way back from the Bell Rock. The Gloamin left in the evening for the Tyne.

Loch Maree.—On March the 18th, the steamer Loch Maree—lately launched by Messrs. Gourlay Brothers & Co., Dundee, for the Loch Line of steamers, of which Messrs. Ireland, Leitch, & Co., are the managing owners—ran her trial trip. The Loch Maree left the roads in the forenoon with a party of gentlemen on board. As the weather was charming, the trial was literally a pleasure trip. A run to test the speed of the vessel was made from the Buoy of Tay to the Bell Rock and back, the mean speed of the two runs being 12.4 knots per hour. This result was considered highly satisfactory. The engines wrought with the utmost smoothness, and reflected much credit on the workmanship of the builders. After the completion of the run the steamer was put on easy speed, and dinner was served. On the removal of the cloth a few toasts were pledged. Mr. Henry Gourlay proposed "Success to the New Ship and to the Managing Owners." The toast was replied to by Mr. Leitch. Mr. Mathewson thereafter proposed "The Builders," responded to by Mr. Gourlay. The Loch Maree returned to the river about four o'clock. Owing to the splendid weather the trip was greatly enjoyed by all on board.

The Villarino.—The new screw steamer Villarino, just completed by Messrs. Laird Brothers for the Argentine Government, and intended to be employed as a transport and storeship, made her official trial trip, at the mouth of the Mersey, last month, and the results obtained were highly satisfactory to all concerned, the vessel attaining a speed of nearly 12 knots, or fully a knot beyond that stipulated by the contract. The Villarino is an iron vessel, 180 feet long, 30 feet beam, and 14 feet deep in hold, fitted with engines of 800 indicated horse-power. She is now completing for sea in the Birkenhead Dock.

Litoral.—On the 20th March the new steamer Litoral, 600 tons, built by Messrs. H. M'Intyre & Co, Paisley, having completed her equipment in Kingston Dock, went on trial for the purpose of adjusting compasses and running the usual trip at the measured mile. This was considered satisfactory, the vessel's speed being 10 knots, and the engines working smoothly. She returned to Glasgow in the evening to take in coal, preparatory to starting for the River Plate, where she is to be employed in passenger and cargo traffic, for which she has been specially constructed.

Copenhagen.—The paddle steamer Copenhagen, built and engined by Messrs. Lobnitz, Coulborn & Co., in 1867, for the mail service between Copenhagen and Aarhuus, having been found by her owners too small for their rapidly-increasing traffic, has been lately returned to the builders for lengthening by 33 feet, and to receive new boilers, and increased passenger accommodation. On Saturday she went her trial trip between the Cloch and Cumbrae Lights, and easily attained a speed of 16 miles on two consecutive runs. This vessel is the property of the United Steamship Company, of Copenhagen. It was formed in 1867, and has proved so successful that the company now has 56 steamers running in different trades and on various mail routes, viz., from Copenhagen to Great Britain, Iceland, Russia, France, Belgium, Norway, Sweden, Holland, and various ports in the Baltic, and is the largest steamship company in the north of Europe.

MESSRS. DIXON & Co., at their extensive shipbuilding premises at Middlesborough, are full of work, having several large ships in various stages of construction. They are now employing about 1,300 men.

IT is now estimated that the iron shipbuilding-yards on the Tyne will be well employed for the next six months in executing the orders on hand; but the rise in the price of iron, it is feared, will put a stop to new orders, and after July there will be a cessation in the construction of new iron vessels.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

PRIMING IN MARINE BOILERS.

To the Editor of the MARINE ENGINEER.

SIR,—Your correspondent, "Chief Engineer," calls my attention to his letter in No. 9. Vol. 1. I read his letter and considered that it fully answered and met "Puzzled Engineers'" enquiry. I have not seen any boilers prime for years past, for the reason that "Chief Engineer" gives. I have gone through his "general rule," viz., "4½ in. in height, from tubes to crown for every foot the boiler is in diam.," and find that it is as near as possible to the proportions of the boilers I have been accustomed to—before the introduction of Compounders' boilers with steam at from 14 lbs. to 25 lbs. pressure, did prime and very badly when entering fresh water rivers; the "tallow kettle" was then the infallible remedy, *but* at the same time the steam was lowered by checking the draught, and the donkey pumped in cold water.

A great improvement has been made in the design of marine boilers during the last 12 years, and although there may be a few badly constructed boilers, still at work, it is generally admitted that the old nuisance of priming is a thing of the past.

There is one remark I would like to make on this subject, it is this—many an engineer believes his boiler priming merely because it *appears* so to him—for instance, the boilers are "run up" to higher level than the average, the engineer "standing by" opening his valves full, and suddenly draws the water from the boiler into the cylinders. The man in the stoke hole seeing the water unsteady, reports "priming," and in the majority of cases it is accepted as fact. One can scarcely advise "Puzzled Engineer." He seems to be in charge of a troublesome kettle, and no doubt the "owner" would think twice before he went to the expense of alterations. "P. E." had better try the suggestions he has received through the medium of the MARINE ENGINEER. A few tubes drawn out will not entail any expense. Let him keep his water as low as possible in the boiler, and his engines "throttled." It is better to go a little slower, especially in heavy weather, than to risk the cylinders. Tallow may help him a little, or better still, the valve oil used for high pressure steam.

The "inch pipe" alluded to, seems to me to be the old "splash" plate in another form. It certainly cannot prevent "priming," though it will keep back a large quantity of water going into the steam pipe, when priming is going on. Chief Engineer's criticism on Mr. Alington's figures is amusing. A model after Mr. A.'s design would be worth seeing. I shall be glad to hear Mr. Alington go further into his theory of the "loss of weight" occasioned by the withdrawal of the wonderful 8 foot tube.

I am, Sir,
Your obedient servant,
"CHIEF ENGINEER."

PRIMING IN MARINE BOILERS.

To the Editor of the MARINE ENGINEER.

Cardiff, March, 1880.

SIR,—As a subscriber to this paper from its commencement, you will excuse me expressing my pleasure in noticing the various practical ideas which the correspondence inserted in it, on the subject of Priming, has brought out, particularly the practical, as I think they are more in accord with the present age of progress than I have seen. I have long looked for practical hints on the management of marine boilers, and have almost come to the conclusion that the authors of the day are in the dark on that subject, especially in regard to their priming and internal corrosion, the two greatest evils the engineer has to contend with, so little definitely is published.

Having lately arrived in England, I hailed with delight the spirited correspondence in regard to priming, and would beg to bring the subject of internal corrosion before my fellow-readers, its cause, and cure; believing that it will furnish matter for discussion for some time to come, having still in my memory a paper read in Scotland about the time of the first issue of this paper, which I recognized was more on the point than I had seen elsewhere. I have for some time been surprised at the obsolete examination of candidates as engineers on the subject of the safe working density of the water in our compound surface condensing boilers, seeing that the salinometer is not in my opinion an instrument to inform an engineer of the dangerous agent at work, destroying the very vitals, as it were, of the boilers in his care, and wondered there is no one in authority able or willing to give us a rule or system to work by. It appears to me engineers are left to get wrong (not having a standard guide), before any notice is taken, and then a victim may be brought up before a court of inquiry of local magnates (holding as diverse opinions as their local residence) to answer for some fault brought before them, and no rule or law to guide either judge or culprit.

I have had some experience myself with compound engine boilers, old and new, in both Atlantic and Mediterranean trades, could easily keep a density of 8 ozs. per gallon, occasionally blowing off top or bottom, laying a nice scale on after 30 days steaming without suffering any local corrosion or pitting in days gone by at 50 lbs. pressure, but lately I have had a pair of boilers at 75 lbs. which work quite different, pitting deeply in spite of every care I could take. I got a good scale on them, and have found it at work fiercely under it, proving to me that the scale is no defence; I am puzzled at it taking place, having worked the boilers as before. Sir, would you lay this before my fellow-readers, soliciting an interchange of ideas on this subject, it might ventilate the subject and be a guide to my junior brethren, bringing about an unison of practice, and oblige,

Yours truly,
"PRACTICUS."

THE POSITION OF NAVAL ENGINEERS.

To the Editor of the MARINE ENGINEER.

SIR,—In No. 9, Vol I., of the MARINE ENGINEER, we have a paragraph on the position of Naval Engineers, where they ask for an improvement in their pay and rank. The Admiralty cannot be ignorant of the immense increase in the Engineer's duties, or they would not so clearly define them—then why do the gallant lords so grudgingly dole out such small improvements in status and pay? I believe, Sir, until the public put on a pressure, H.M.'s Engineers, and all marine engineers will remain just where they are at present, a little above the warrant officers. At any rate doctors, parsons, paymasters, or pursers rank first, and have privileges or perquisites which the engineer cannot get—yet contrast the responsibilities. It must be granted that the naval engineer to-day is as much a "combatant officer" as the Admiral or Captain. If the engine room department is at fault during an action, everything else must go wrong—the ship can no longer manœuvre. On the other hand supposing the doctor, paymaster, or parson, were all laid up or asleep, the result of the action would not be affected thereby. Surely then, admitting this, the engineer ought to have his proper place in rank, that is, as a fighting officer, and his pay ought to be increased in proportion to the value of the property he controls. I fear the old spirit of envy and jealousy exists at the Admiralty as well as other marine boards. The engineer is still associated with "grease," "india-rubber," and "low-breeding," and by the executive officers as "interlopers," and fellows who have no right on the ships if on the sea. But as long as the success of a voyage depends on speed and machinery, so long will the engineer be considered something more than an ornament by his employer. A ship owner is liable to lose more money through an incompetent staff of engineers than people are aware of, it is therefore to the interest of the world at large that the engineering profession in all its branches should no longer be kept out in the cold, but be entitled to all the privileges and honours of the senior professions. No doubt some of the daily papers would bring the engineer's claims more prominently forward, if the editors had some intimate knowledge of the duties of the "engine-room." We often see a graphic account of some large ship foundering at sea, with heavy loss of life, but no mention of a practical remedy, though several are at hand; if only the public, the travelling portion, would demand them, there seems to be a chasm between the scientific papers and the political ones, and the subjects which are brought before and intended to benefit the world, are only circulated in our own little sphere.

I am, Sir,
Yours, &c.,
"TORPEDO."

BOARD OF TRADE EXAMINATION.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Bruce, James	2 C	Abrdn.
Lockhart, Dvd.	1 C	do.
M'Dowell, M.	2 C	Belfast.
Wisnom, Hugh	1 C	do.
Urquhart, Geo.	2 C	London.
M'Phedran, D.	2 C	do.
Newby, C. G.	1 C	do.
Grant, Robert	1 C	do.
Carr, James	2 C	NShields
Stenhouse, Adm.	2 C	do.
Fussholter, E. C.	2 C	do.
Taylor, J.	2 C	do.
Smith, John	2 C	do.
Russell, Wm.	2 C	do.
Landells, Alex.	1 C	do.
Nielson, J. M.	1 C	do.
Stewart, Wm.	1 C	do.
Knowles, Wilson	2 C	Lvrpool.
Lillie, Jno. A	1 C	do.
Walker, M. G.	1 C	do.
Forster, Anthony	2 C	Glasgow.
Robertson, Jno.	2 C	do.
Blackwood, J. D.	2 C	do.
Elder, Thos.	2 C	do.
Esdaile, Jno. P.	2 C	do.
Morrissy, John	2 C	Cork
Davies, Robert	2 C	Lvrpl.
Innes, James	2 C	do.
Quillish, Hny.	2 C	do.
Wildish, F. W.	2 C	do.
Mitchell, David	2 C	Leith.
White, Robert	2 C	do.
Bowman, Wm.	2 C	do.
Keir, James	2 C	do.
Wilson, Geo. C.	1 C	do.
Porteous, Alex.	1 C	do.
Forbes, D. A.	1 C	do.
Farmer, Dvd. B.	1 C	do.
Smith, Wm.	2 C	London.
Richardson, G.	2 C	do.
Anderson, W.C.	1 C	do.
M'Farlane, Wm.	2 C	Plym'th.
Towell, Wm.	2 C	NShlds.
Cromach, J. H.	2 C	do.
Sadler, W.	2 C	do.
M'Kenzie, Jno.	2 C	do.
Whitfield, Wm.	1 C	do.
Brander, A.	1 C	do.
Parsons, Wm.	1 C	do.
Scott, Robt.	1 C	do.
Barrie, Alex.	2 C	London.
Smith, Wm.	2 C	do.
Squibb, Arthur	2 C	do.
Butterfield, A	1 C	do.
Dick, Jno. N.	2 C	Lvrpool.
Murry, Andrew	2 C	do.
Henderson, W.	1 C	N Shlds.
Inkpen, Wm. S.	1 C	London.
Ridyard, A.	1 C	Lvrpool.
Clucas J. E.	1 C	do.
Carr, Thos. R.	2 C	Sndrlnd.
Chisholm, Rbt.	2 C	do.
Dodds, Wm. H.	2 C	do.
Garson, John	2 C	do.
Holder, Wm.	2 C	do.
M'Intosh, M.	2 C	do.
Todd, George	2 C	do.
Todd, William	1 C	do.
Hansen, J. M.!	1 C	do.
Adam, Benjmn.	1 C	do.
Mudie, David	1 C	do.
Kinley, Wm.	2 C	London.
Gardner, Gavin	2 C	Glasgow.
Brown, Thos.	1 C	do.
Colquhoun, W.	1 C	do.
Hamilton, W. D.	1 C	do.
Gilchrist, P. B.	1 C	do.
Watson, Andrew	1 C	do.
Stewart, J. C.	1 C	do.
M'Pherson, John	1 C	do.
Beynon Duglas	1 C	London.
Clark, Thos.	2 C	N Shlds.
Reynard, Jas.	2 C	do.
Wright, Peter	2 C	do.
Newby, C. H.	2 C	do.
Everson, Robt.	2 C	do.
Donaldson, C.E.	2 C	do.
Beagle, Jno. E.	2 C	do.
Terry, Stephenson	2 C	do.
Joel, John T.	2 C	do.
Spence, Rbt. T.	1 C	do.
Howie, Joseph	1 C	do.
Duncan, George	1 C	do.
Golightly, John	1 C	do.
Wotherspoon, A.	2 C	London.
Blair, Thos.	1 C	Lvrpool.
Downie, John	1 C	do.
Keith, H. M. D.	2 C	Grnock.
Holmes, James	2 C	do.
Dunn, James	2 C	do.
Brown, Jas. C.	2 C	do.
M'Farlane, P.	2 C	do.
M'Kinnon, Wm.	1 C	do.
M'Lacklan, R.	1 C	do.
Sinclair, Robt.	1 C	do.
Davie, Jas. B.	1 C	do.
Martin, Rbt.	2 C	Hull.
Walker, Ed. J.	2 C	do.
Swan, A. G.	2 C	do.
Sherran, R. J.	2 C	Sthmtn.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

THE attention of the Mersey Dock Board has been drawn to the danger threatening the landing stage by the rapid advance of the Pluckington sand bank. The bank has extended to such a degree under the south end of the stage that at the time of low water a considerable portion of the structure is aground. The effect of this was to cause an enormous strain upon the pontoons and bridges, and also upon the booms which steady the stage, and it was feared that they would break under their additional weight. Mr. Holt said the Marine Committee could not assign any reason for the encroachment of the bank. It was always moving, and the changes in it were very obscure. This was not the first time that the same thing had happened; the bank had gone back as mysteriously as it had advanced, and their only hope was that it would do so again. Mr. Brocklebank said the board should bear in mind that if they removed the bank altogether it would probably lodge somewhere else, and the chances were that it might lay itself down before one of the dock entrances, and so cause greater mischief and inconvenience than it did at present.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 20th February to 18th March, 1880.

Prepared especially for THE MARINE ENGINEER *by Fell and Wilding, City Patent Office,* 23, *Rood Lane, Fenchurch St., London, E.C.*

745. B. Walbank. Grate bars of furnaces.
746. A. Barclay. Long span bridges.
750. C. G. Y. King. Steam Steering Engines and Gear.
757. L. Thomas. Apparatus for raising and lowering ships' boats, &c.
770. J. B. Hannay. Anti-fouling and anti-corrosive Compound applicable to ships' bottoms, submerged structures, and generally for protection of exposed surfaces.
781. Sir W. Thomson. Navigational sounding apparatus.
787. W. Shears. Rowlocks.
788. J. Mitchell. Stoppers or breaks for iron and steel wire rope cables or hawsers.
797. W. R. Lake (communicated by J. B. Sheppard). Speed regulator for engines.
800. T. Henderson. Furnace fronts, doors, dead plates and their appurtenances.
808. T. Britton. Construction of steam and other ships for carrying grain and other cargoes in bulk.
813. W. Gibson and J. S. Nicholson. Engine governors.
814. J. H. Johnson (communicated by F. A. Gower). Telephone wires or cables.
825. J. F. Flannery (communicated by L. A. L. Irving). Distilling.
833. A. H. Vernon. Taps for liquids, steam, &c.
834. W. C. Johnson and S. E. Phillips. Moorings for buoys, specially applicable to buoys for marking positions in connection with the laying of telegraph cables and marine surveying.
853. N. E. Nash. Steam engine governors.
873. T. Adams. Safety valves.
895. G. F. Redfern. (Communicated by F. W. Brainerd). Steam boiler and other furnaces.
901. S. Chamanski. Apparatus for saving life and property at sea.
909. L. Varicas (communicated by W. M. Fisher. T. T. Heath, A. and C. Lawrence, and J. A. Gano). Steam boilers.
910. H. J. Haddan (communicated by R. L. Shute). Hoisting blocks
911. F. W. Durham. Regulaton of steam supply to engines.
944. W. R. Mowbray and E. Murby. Apparatus for attaching air vessels or other lifting agent to sunken ships.
957. W. R. Oswald and G. Starers. Construction of ships to carry cargo in bulk.
970. John Mitchell. Lubrication of working bearings of marine engines and similar surfaces.
996. J. G. S. Anderson. Construction of ocean steamers.
1011. E. C. F. Otto. Pulleys.
1023. R. H. N. Alleyne. Hand control of engines.
1041. G. W. Garrett. Injectors.
1056. J. McLennan and R. Owen. Propelling vessels.
1060. J. Ramsbottom. Apparatus for working expansion valves of steam, air, or gas engines.
1067. F. J. Brougham (communicated by Serpollet, Freres & Cie.). Generating steam.
1073. E. Bond. Apparatus or mechanism for hoisting and lowering boats or yards.
1109. H. W. Cook. Motive power engines, regulating same, and heating feed water of steam boilers.
1122. J. Stanhope. Elevators and conveyors.
1123. E. H. McNeil. Steam boilers.
1127. H. J. Haddan (communicated by H. Heimann.) Preventing incrustation of boilers.
1130. W. Bagshawe. Dredger-bucket backs and links.
1153. M. Stuart. Ballasting ships, &c., ballast and containers for same.
1155. W. Clark and W. M. Swanson. Vertical steam boilers.
1166. A. M. Blair and C. Fairbairn. Transmitting motive power.
1169. G. Cranstoun. Expansion valves.
1176. Sir J. Coode. Apparatus for landing or delivering sand, mud, &c., from barges, &c., especially when raised by dredging.
1179. W. Ullmer. Rotary engines.

ROBERT WALKER'S PATENT HYDRO-CARBON FURNACE AND APPARATUS

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals, &c.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel, burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; the equivalent in Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in the case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no sparks or burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c., and economy in voyage.
8.—Cleanliness, and easier and quicker voyages.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, &c., without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

THE INVENTORS' RECORD—"Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walser, C.E., F.R.G.S., (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with the coal."

THE RAILWAY RECORD states, "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers."

The MARINE-ENGINEER.—"For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage."

INDUSTRY.—"At a trifling cost an enormous degree of heat was easily attained, estimated at 5000 degrees by which iron was easily melted in ten minutes, instead of taking in ordinary circumstances two hours, and glass in two hours instead of sixteen."

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"These advantages are immense, and must eventually effect a complete revolution in our present mode of steam generation."

For prices, &c., and for terms for working this patent under royalties or licences or otherwise, apply to the patentee, Mr. R. Walker, 19, Buckingham-street, Strand, W.C.

NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

The Marine Engineer,

LONDON, MAY 1, 1880.

EDITORIAL NOTES.

THE South Pole is at last receiving a little attention. For many generations the North Pole has been the scene of exploring enterprise and disastrous failure, but nothing has been done with regard to the South Pole. We cannot ourselves see what there is at either pole to cause such a series of painful and disastrous efforts to reach the inaccessible, except the difficulty of getting there. The Italians are on this occasion coming to the fore. They have taken the South Pole under their immediate and patronizing protection, and they are about to fit out an Arctic vessel suited as far as possible to reach that frigid and inhospitable clime. To our minds the vessel must either be constructed to fly or to swim under water, to have any chance of penetrating the enormous wall of ice cliffs which are known to surround that unknown imaginary sea at the South Pole, where it is believed the sea is never frozen. As, however, the sum required for the expedition is 600,000 lire, and it has to be supplied by public contribution, the Italian expedition may find an impassable barrier before they even leave their own country. However, should they start, they will have all England's sympathy with them, and best wishes that they may get well out of it. They will use the Tierra del Fuego as an intermediate coaling station, from whence the chief difficulty of the expedition will occur. They hope to discover unknown continents within the Antarctic circle, possibly form colonies there, but, at any rate, to so open out the way that Italy may there establish flourishing whale fisheries. The commanders who have projected this exploration are the Commendatore Negri and Lieutenant Bove.

EVERYBODY has heard a great deal about the depression in our shipping trade. It is supposed to have been so bad that vessels have been lying and rotting at their anchorages for want of employment. This has no doubt been the case, but it appears to have been also very largely the fault of the shippers or shipowners themselves. From statistics before us it seems that the tonnage of goods carried by the English shipping was larger in amount last year than in any previous year; and that this amount has steadily increased year by year. There has thus been no absolute want of freights at all, and no decrease beyond that of former years. Whence then came the depression that has been so complained of? It has been caused by the fact that the shipping has always increased at the same rate as the freights, and when the rate of increase in the freights fell off, the increase of shipping did not correspondingly fall off for some time. So after a while the shipping was in excess of the freights that were to be had, and the consequent depression in value of freights followed with the enforced idleness of much of the undue excess of the shipping. The increase of shipping was thus checked to suit freights, and as freights increase we shall, we hope, soon see the balance once more restored, and freights rising rapidly to remunerative rates.

We think that our correspondent's suggestion last month, that important information may be elicited from our readers with respect to boiler corrosion and incrustation, is very much to the point. There is no doubt that there is as little really known about the true course and action of corrosion as there is about priming. The various suggestions and practical hints given by our correspondents upon priming we consider to be of great value; and a little compilation of various experiences in boiler corrosion may be extremely beneficial in enabling us to determine a general principle affecting the subject, and a course of precaution to avoid it. Corrosion, we consider, is always chemical action of one sort or other. In some cases it may be the direct formation of chloride of iron by combination of the iron with the chlorine contained in large quantity by the sea salt. On the other hand, it is said that distilled water, that is, the condensed exhaust steam fed back into the boiler, has a very deleterious effect upon the iron plates. This is difficult to understand, as condensed water is the purest form of water, and thus precludes the idea of chemical action. We think, rather, that the bad effect of condensed steam returned to the boiler is owing to the grease or other impurities contained in it which have been taken up in the cylinders. Another very general surmise is that corrosion is the result of electrical currents. In furtherance of this theory it is well known that where two different metals meet—as, for instance, the homely case of iron railings bedded with lead—the most oxidizable metal, such as iron, is eaten rapidly away, even in the open air. A well known fact, also known to ourselves, is that zinc may be used in a boiler to prevent scaling or deposit; the zinc entirely *disappearing* in a few months by electrical and chemical *action. It is said that so long as* the zinc in the form of clippings or lumps is present in the bottom of the boiler no electrical corrosion of the iron shell can take place, as the iron is positive to the zinc, in electrical parlance, and the zinc must therefore waste first. The shell, where it meets the ends, and the joints of boilers, are also peculiarly liable to corrosion; why, we cannot very well pretend to say, except that these points are the meeting places of different sets of electrical currents. It may not be known that the escape of steam through a pipe or orifice sets up powerful electric currents in the material through which it is escaping. We shall be glad to see a practical discussion and a collection of practical evidence on these points from our readers.

We were surprised to note the other day that the Admiralty have been carrying out the fitting up of torpedo boats in such a blundering fashion. Instead of having the boats designed and fitted up from a complete specification or design to suit the requirements of torpedo warfare, we are surprised to hear that they were in the habit of allowing our best fast launch builders to supply the boats without the torpedo fittings, and then immediately began to pull the boats almost to pieces, altering the position of the funnels, shifting bulkheads, or effecting other structural alterations. As engineers, our readers will easily imagine the patchwork produced when once such alterations had been commenced, and even then the method of discharge seems to have been singularly ineffective. In some cases the projectile is discharged from a pneumatic tube in the bows, and in others the torpedo is discharged from swinging cradles lowered amidships from the side of the boat. The Admiralty only seem to have just discovered that this mode of discharge is singularly inefficient. In the first case the men operating the pneumatic tube seem to be wholly exposed to the fire of the enemy. In the latter case the progress of the boat must be arrested before an efficient discharge can be made. At last it seems to have struck the Admiralty as a "happy thought" to have the torpedo boats designed and supplied to discharge torpedos in the most efficient manner possible, and we understand that to Messrs. Yarrow & Co., the well-known launch builders, belongs the credit of suggesting such improvements as will produce a torpedo boat properly constructed for the service it is intended to perform. In these new boats all the torpedo gear is arranged for and fitted up complete in the building, and the old method of discharging from a cradle is dispensed with. Two troughs are built into the forward part ot the boat, in which two torpedoes can lie ready for use. Immediately behind, and protected by a turtle shield, are two compressed air tubes by which the torpedoes can be discharged by the officer in charge without exposure and without loss of speed to the boat. This sounds something more like business, and only shows the value of Government work being done by outside private contractors, who may be blessed with some commercial ideas and ingenuity.

We have felt a dreadful scare from the crushing statements of Admiral Symonds during the past month as to the deplorable relative strength of our navy. Admiral Symonds considers that there is already one power as strong on the sea as we are. In Nelson's time, our strength at sea is stated to have been double that of the strongest naval power, and yet we were not nearly so dependent for our very food and existence as we are now upon the command of the sea for the protection of our enormous commercial marine. Our present ironclads are branded by Admiral Symonds as "generally bad and obsolete, built under the advice of old sailors bigoted to masts and sails. The greater part are unmanageable under sail, and are bad steamers, stopped by a moderate gale because they are over-masted, while the same over-masting ruins them as fighting ships ; and they are made ready for a bonfire by the sailing ship stores with which they are encumbered above and below." This is certainly an overwhelming attack upon England's iron walls, and we cannot but presume that Admiral Symonds knows what he states to be true. He further states that he believes that none of the ironclads can carry more than four days' supply of coal under full steam. He considers the only help out of this shameful position is to at once secure or build at least 20 long powerful steamers (of the Transatlantic, Baltic, or Star Line class), to be fitted with twin screws, fore and aft bulkheads, a ram, and torpedoes. These steamers, he considers, would be necessary to in any degree protect our commerce, and to act as tenders to carry coal for our ironclads. He does not think these could be rapidly fitted up in case of sudden war, and therefore presses the necessity to set about building or buying such steamers at once.

Such a view as to the immediate necessity of doing something is more forcibly pressed home upon us from the fact that Russia is moving very promptly and energetically towards the formation of an efficient navy. Besides the new class of Popoff ironclads, of which the precursor is being built at Messrs. John Elder & Co.'s yard, on the Clyde, the Russian volunteer fleet is being actively increased. This fleet now numbers five very fine fast sea-going steamers, all fitted with rams and torpedoes. The latest of these is now building at Toulon, of iron and steel, and is about 310 ft. long, with a displacement of 3,150 tons. She is to have a speed of from 15 to 15½ knots an hour, and is to be armoured with four guns and two mortars, representing a weight of 150 tons. These cruisers are to carry high freighted merchandise, such as tea or silks, in time of peace, and are yet to be immediately available for dangerous offensive warfare at any moment. Here is an ingenious combination of trade and war that is most worthy of John Bull himself. He might do worse than follow such a lead, and make our latest navy additions pay for themselves.

ASBESTOS PACKING.

In the high pressure cylinders now become so common in the compound engine at sea, it is a difficult matter to apply a trustworthy and durable packing. All glands packed with hemp or flax require a very large amount of attention and consequent renewal. Asbestos packing has the character of being practically indestructible. It is not affected or charred by heat, and thus will last almost indefinitely when once fitted and packed in the glands. The asbestos packing, however, at present in the market is generally an admixture of hemp or flax and asbestos, as it is extremely difficult to produce asbestos with sufficient fibre to weave or twist into a practicable packing. We have before us a splendid specimen of pure asbestos packing manufactured by Mr. John Bell, of 118, Southwark Street, S.E., in which the pure mineral nature of the packing is plainly evident. We should certainly imagine that this packing would be practically indestructible, except by very gradual and absolute wear on the piston rod. The great advantage of this packing is that it never loses its elasticity, as is the case with any packing that is charred by heat.

A USEFUL DISINFECTANT.

The construction and arrangement of sea-going vessels necessitate much more attention than they generally receive from a sanitary point of view. When we consider the very confined space in which a number of human beings have to dwell for, at times, a lengthened period, and the difficulty of maintaining proper sanitary conditions we are surprised that more attention is not paid, not only to ventilation, but to the use of disinfectants, in order to neutralize the unhealthy and unsavoury odours which are always perceptible and, on board some vessels, almost unbearable. We have had our attention drawn to a disinfecting powder, manufactured by Messrs. Ledger & Co., of Lant Street, Southwark, which seems especially adapted for use on shipboard. It is itself practically without odour—a great desideratum—and is made in a very cheap and condensed form. Its composition seems to partake largely of chlorine, and this, as is well known, not only possesses highly disinfectant and deodorizing properties, but absolutely *destroys* by neutralization the solid and gaseous alkaline products of decomposition. In vessels carrying meat cargoes or suffering from a foul bilge, and in emigrant ships we should think its use would be particularly applicable.

A New Ship Canal.—According to the plans prepared by Herr Dahlstrom, to whom a preliminary concession for the enterprise has been granted, the proposed ship canal from the Baltic to the North Sea will be traced from the Bay of Kiel to Brunsbuttel, in the estuary of the Elbe. Its depth throughout is to be 20 feet 9 inches; its width at the surface of the water 160 feet, and at the bottom 64 feet, the banks consequently having a very gentle slope. Provision will moreover be made, by the adoption of a peculiar system of locks and reservoirs, for increasing the depth of the water to 25 or 26 feet, whenever it may be desirable to do so ; and this depth will allow of the passage through the canal of the heaviest German ironclad afloat—the Konig Wilhelm, a vessel of 9,603 tons displacement, and the largest ship in the German navy, drawing only 26 feet. The canal can, it is calculated, be completed in six years, and will, it is estimated, cost £3,750,000, or about two millions and a quarter less than the estimates made a few years ago of the cost of constructing a canal 31 feet deep and 224 feet wide at the surface of the water. In size, it may be added, the proposed Baltic and North Sea Canal does not compare unfavourably with the Suez Canal, the width of this at the surface of the water being 172½ feet, the width at the bottom, 70 feet, and the depth about 26 feet 3 inches.

M. Daubourg, a French engineer, claims to have devised a means of transporting large vessels over isthmuses, however steep, and an experiment is shortly to be made at Argenteuil by lifting a 2000-ton ship from the river, and taking it on rails to another point on the river.

THE "NELSON" CLASS.

By N. Barnaby, Esq., C.B., Vice-President.

[Read at the Twenty-first Session of the Institution ot Naval Architects, 18th March, 1880.

IN a table appended to this Paper I give particulars as to the two ships *Nelson* and *Northampton* as they have been completed, including the trials of speed, and I place beside them corresponding particulars of two excellent ships of an earlier type, designed for similar work, the *Iron Duke* and the *Bellerophon*.

I regret to have to admit the fact that, while the *Nelson* is a 14-knot ship on the mile *without* the use of the steam blast, the sister ship, notwithstanding that the engines are the perfection of workmanship and material, is at present only a 13¼-knot ship *with* the steam blast.

The difference is apparently due mainly to the difference in the performance of the two types of engines, and particularly of the propellers, and partly to the fact that, from some unexplained cause, the *Northampton* always needs starboard helm to keep her on a straight course, and this checks her way. When the screws of the *Northampton* are altered, it will probably be possible to greatly reduce the difference between the two ships.

I may be permitted to add that the *Northampton* left Spithead for her station with 1,200 tons of coal in her bunkers, and with her gun-deck portsills 11½ ft. out of water. The *Nelson* will float under the same conditions about 5 in. lighter, and will thus have, with 1,200 tons of fuel, nearly a 12¼-ft. height of port.

Public attention has been called to a discrepancy between the draught of water named when the ship was first designed and that at which she was completed, as though it were desirable to prefer strict adherence to a draught of water to the introduction of newly-devised sources of warlike efficiency.

The designer of the ship should be judged by the performance of the completed ship, and not by the strictness of the accordance between the weights he proposed to put in in 1874 and those which he was prepared to adopt at various stages up to the date of completion in 1879.

The real question concerning the *Nelson* class is, now that they are completed, are they fit for their proposed service?

I shall be prepared to answer any questions concerning alleged discrepancies which may be thought interesting, but what most people will care about is, what services are the ships designed to perform, and what promise is there of due performance?

The ships may be looked at from two points of view. They may be regarded as *armoured ships*, having to meet armoured ships; or as *protected cruisers*.

The very first duty the class is required to perform is to relieve the *Bellerophon* as the flag-ship on the North American Station. I am therefore almost called upon to compare the two ships, and I believe I am sufficiently alive to the good points in both to be able to compare them impartially, so far at least as they can be compared, without either having undergone the stress of war.

The two ships are fairly comparable, for they are about the same size, carry the same crew, and cost about the same money.

It is sometimes supposed that the *Nelson* is a type in which armour is greatly reduced in amount. This is not so. It is reduced in extent, but the average thickness is greater, and the total weight is greater in the *Nelson* than it is in the *Bellerophon*.

Covering in the entire battery of the *Bellerophon* with armour, and extending the armour to the extremities at the water line, makes it necessary to be content with an average thickness of the vertical armour throughout the ship of 5·28 in.; whereas in the *Nelson* the average thickness of the vertical armour is 7·28 in.

So far, therefore, as there is an attempt to protect with armour, the average thickness of the protection will be nearly 38 per cent. more than that in the *Bellerophon*. I do not compare the squares of these thicknesses in the usual way, as representing the relative strengths, because for the greater portion of the blows received from shells in action the thinner armour will probably be impenetrable.

The armour is suppressed at the ends of the ship, and an under-water deck is substituted for it. Beneath this deck aft, is situated the steering gear and the rudder-head, so that it is far more secure than it is in the *Bellerophon* where it is all above water, concealed from view, and protected by thin armour, as is usual in belted ships.

I do not attach special importance in this comparison to the twin screws of the *Nelson* against the single screw of the *Bellerophon although, I suppose,* we are all agreed that in action the double propeller, the alternative mode of steering, and the power of turning without advancing, are of great value. This came out in a most marked manner in the combat between the *Huascar* and the Chilian ships of war.

The *Bellerophon* has greatly the advantage in the weight of the broadside fired from protected guns, and in the fact that, except at the ports, the battery walls are protected against the perforation of most shells, while the central part of the *Nelson's* armament is exposed to the entrance of any projectiles which could get through an inch plate. But the *Nelson* is much the more heavily-armed ship; the total weight of the armament being, *Bellerophon* 420 tons, *Nelson* 533 tons.

The power of the *Nelson* in the right-ahead and right-astern attack, both offensively and defensively, is also greatly superior to that of earlier ships.

The *Northampton* carries comfortably two 60-feet torpedo boats of 16 knots speed, in addition to the service of boats required in a flag ship. The total weight of the boats carried is nearly 40 tons.

Regarding the class as designed for cruising, it is to be observed that, with 4,000 horses, say two-thirds power, the ship goes in smooth water 12¾ knots. With average coal she may therefore steam at an average ocean speed of 12½ knots, with a consumption for all purposes of 100 tons per day. For twelve days at this speed the distance covered would be, without the use of sail, say 3,500 knots. With 2300 horse-power she obtained in smooth water a speed of 10,537 knots, so that, with 60 tons per day, she should make a 10½ knots average ocean speed, and should steam 5,000 knots.

I am fully sensible of the large consumption of fuel for a given speed as compared with the long narrow merchant ship, and of the corresponding loss in coal endurance; but it is always necessary to remember that the ship of war is endowed with a powerful rig, enabling her to cruise under sail for any length of time with no appreciable consumption of fuel, whereas the merchant steam ship is helpless under canvas—she can only drift before the wind.

To show the difference in the distribution of the weights in such a ship as the *Nelson*, and a first-class passenger steamer of the same displacement and designed for the same average ocean-going speed, 12 to 12½ knots, I have placed them side by side in the following Table:—

	"Nelson." Tons.	Passenger Ship. Tons.
Hull	3,017	3,200
Propelling machinery	1030	700
Armour	1,720	...
Armament	533	...
Rigging, stores and equipment ...	633	450
Coal	1,200	3,750
	8,133	8,100
Consumption per hour at 12 to 12½ knots average speed	4	3

The gain in consumption in favour of the merchant ship is due to the fact that the speed is obtained in her with less engine power because her proportions are more favourable to speed, and especially to ocean speeds. The length of the *Nelson* is only 4⅔ times the breadth, while that of the merchant ship is ten times, her length being 420 ft. and her breadth only 42 ft.

Before reading the above, Mr. Barnaby offered a few remarks in explanation of the brevity of his paper, and on the fact that it left some things which needed explanation unexplained. He said difficulties had arisen in getting the trials of the *Nelson* completed to compare with the *Northampton*, and that before the results were fairly in his hands he had to leave England. He therefore completed his paper rapidly, and sent it in, fearing he might not be back in time to lengthen it or read it himself. He promised, however, to deal with the subject at greater length next year.

Sir Spencer Robinson congratulated Mr. Barnaby that he was able after the lapse of 16 years to turn round and say this work which I now do is superior to that which I did 16 years ago. And especially was this the case when the comparison was made, not with an ordinary ship of the earlier period, but with one like the *Belerophon*, which was in herself a remarkable advance on all that had gone before her. Speaking of the coal supply he said it was a source of satisfaction to him to be able to say that there is no ship of war of any nation or country of anything like the power of the *Nelson* and *Northampton* that carried the same amount of coal they carry, and he attributed that to the fact that Mr. Barnaby had not been trammelled in the design by those in authority over him. He said he intended to have asked several questions, but as further information had been promised next year he desisted. Mr.

Barnaby had, however, cleared one point by making it plain that the draught of water given at the trials did not include the 1,200 tons of coal. He did not think with those who held that when such vessels were deeper in the water they would give better results on account of the deeper immersion of the screws. He thought the somewhat greater draught of water of the *Northampton* accounted in some measure for her inferior performance to the *Nelson*. The speaker alluded to the absence of protection to the gunners on the broadside, but after weighing carefully the subject, and although differences of opinion would exist, he concluded in favour of the arrangements made in the *Nelson* and *Northampton*. He did not agree with giving the vessels masts and sails as well as two screws, and remarked that he had always insisted upon the importance of speed for our smaller classes of cruising vessels.

	Nelson.	*Northampton.*	*Bellerophon.*	*Iron Duke.*
Length	280 ft.	... ...	300 ft.	280 ft.
Breadth	60 ft.	... ...	56 ft.	54 ft.
Mean draught of water...	24 ft. 7 in. ...	25 ft.	24 ft. 8 in.	22 ft. 8 in.
Displacement	7,473 tons ...	7,652 tons	7,550 tons	6,010 tons
Indicated power of engines	6,624 (twin screw) ...	6,073	6,520 (single screw)	4,020 (twin screw)
Speed on mile at normal draught	14 knots ...	13·173 knots	14·17 knots	12·83 knots
Weight of protective plating and backing ...	1,720 tons ...	... ...	1,273 tons	1,082 tons
Average thickness of vertical armour... ...	7·28 in. ...	... ...	5·28 in.	5·77 in.
Weight of armament	533 tons. ...	... ...	420 tons	351 tons
Weight of projectiles in a broadside	1,800 lbs. ...	... ...	1,595 lbs.	1,378 lbs.
Weight of projectiles thrown right ahead ...	800 lbs. ..	... ...	230 lbs.	628 lbs.
Weight of projectiles thrown right astern ...	800 lbs. ...	... ...	115 lbs.	628 lbs.
Cubic feet of space per gun in enclosed midship batteries	6,000 ...	... ...	3,200	4,000
Coal-carrying capacity	1,200 tons ...	... ...	645 tons	460 tons
Area of canvas in plain sail	24,770 sq. ft. ...	... ...	23,400 sq. ft.	22,750 sq. ft.

Mr. A. C. Kirk said he had a practical connection with these ships, for his present firm were the builders of the *Northampton*, and the design of the *Nelson's* engines, and to a large extent the superintendence of their construction, fell to his own share. Speaking of the difference of speed he said that after making allowance for the difference of horse power and for the difference of draught, the difference of speed was not accounted for and as the ships were alike, the difference must be in the propellers. He thought, like the case of the *Iris*, it was worthy of investigation. A peculiarity was that the screw blades in the *Nelson* which did so well were like those of the *Iris* that proved unsuitable for her, whereas the *Northampton* that performed so indifferently had ordinary two-bladed Griffiths screws. Mr. Kirk gave further particulars as to the arrangement of the blades of the *Nelson's* propeller, which was so contrived chiefly to avoid undue resistance when the vessel was under sail, but had also proved itself an advantageous arrangement for propulsion. He remarked also that in his opinion these two ships supplied a crucial test of the comparative worth of single and compound engines. When the Admiralty asked for designs for these engines, they requested the contractors, in order to save weight, to arrange that the engine framing should somehow be incorporated in the structure of the ship. In carrying the design out, the two makers of the engines followed very different courses. In the *Nelson* the ordinary two-cylinder compound engine was adhered to. In the *Northampton* the arrangement was such that when the engines worked at full speed they acted in simple surface-condensing engines. The results, he thought, amply justified the selection of the compound engines where lightness is required in proportion to the power, even putting aside the question of coal economy altogether. He thought it was an entire mistake to suppose lightness could be got by limiting the range of expansion, and doing it in one cylinder. The weights of these two engines were, *Nelson* (compound) 998 tons, *Northampton* (compound, but worked as simple engines at full power) 1113 tons, which difference, he thought, went a long way towards explaining the difference of draught of water. Again, comparing the power developed, the *Nelson's* compound engines, without the use of the blast, developed 6624 horse power, whereas the heavier engines of the *Northampton*, with the blast, developed only 6073 horse power. Had the blast been applied to the *Nelson's* engines, and the pitch of the screw been fine enough to allow the steam to be used, there would have been no difficulty in getting 7,000 horse power.

Again, coming to the rate of coal consumption, which was of the utmost importance in vessels such as these, the proportion at full speed was in the proportion of *Nelson* 2, *Northampton* 3, or in other words, the *Northampton* burns 50 per cent. more coal than the *Nelson* to do the same work, so far as her engines are concerned, putting aside altogether the question of propulsion. Altogether, he considered these trials most conclusive, and when Mr. Barnaby spoke of the engines of the *Northampton* being the perfection of workmanship and material—as they undoubtedly are—he must have been conscious that these qualities alone were not sufficient to produce the best engine.

Mr. Scott Russell agreed with Mr. Barnaby in the arrangement of the armour on these ships, and did not agree with Sir Spencer Robinson in his objection to leaving the broadside of the battery unprotected with armour. He also agreed that it was desirable to protect the engines, boilers, and magazines so as to relieve the men at the guns from all fear of being blown up from below.

After a few words from Mr. Barnaby in reply, the President expressed the thanks of the meeting to him for his very able paper on a very interesting and important subject.

ON A METHOD OF ANALYSING THE FORMS OF SHIPS AND DETERMINING THE LENGTHS AND ANGLE OF ENTRANCE.

By A. C. Kirk, Esq., M.I.C.E., Member.

[Read at the Twenty-first Session of the Institution of Naval Architects, 18th March, 1880].

As Mr. Denny last year, in the course of discussion, alluded to a method I have been in the habit of using to find the mean angle of a ship's entrance and its length, and as some of my friends have used it, it may not be out of place briefly to lay it before this Institution.

My first steps in working it out were made fully twenty years ago, in tabulating some progressive trials then made by the Admiralty on the *Flying Fish* and another ship, but as my attention was for several years after that directed to other branches of engineering, it was laid aside and not seriously resumed till Mr. Denny put before us, in a strong light, the value of progressive speed trials, and showed the important information that might be got from them.

The great fact he pointed out was that we could, by this process, ascertain, in the case of each ship thus tried, the relation between power and speed, and he showed how this could be simply and usefully expressed, graphically, by a curve.

Following Mr. Denny, I adopted the progressive method of making speed trials, and quickly collected a considerable amount of valuable information. In applying this information, to find the power and speed of other ships, I found it necessary to analyze the forms of the ships I had tried—above all, to tabulate their length of entrance, of middle body and run, and also the mean angle, and thus compare them, in these essential elements, with those of the ships in question.

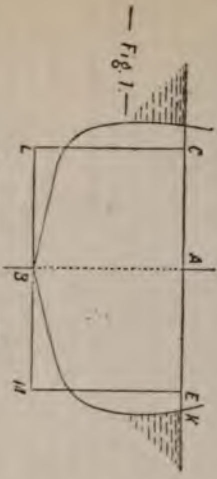
The method of measuring the angles, or the length of entrance of the water-lines, proved so utterly vague—depending, as it did, to a large extent, on the judgment of the assistant—as to be all but worthless.

For instance, lines may be hollow, or they may be convex, or the vertical sections may be fine while the horizontal sections are full, in which cases it will be impossible to lay down any rule applicable to all. Neither is the co-efficient of fineness alone much of a guide by which to compare the forms of ships.

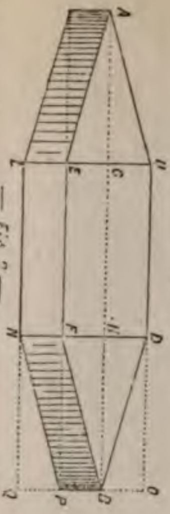
The following was the method adopted—and here I may premise that for ordinary purposes I assumed that the length of entrance and run were equal; in fact I contented myself by finding the mean of the lengths and angles of entrance and run, but the method is equally applicable to finding them separately when greater accuracy is required.

I shall now give the process for finding the mean length and angle of entrance and run.

Construct a block-ship, having the same displacement, mean draught and area of midship-section as the ship under consideration, but with rectangular sections, parallel middle body (if necessary) and straight-sided wedge-shaped ends. Fig. 1 shows by the curved line I B K the midship-section of the actual ship, and by the rectangle C L M E the midship-section of the block-ship, both sections being equal in area and depth, having a common water-line I K. The depth A B is the mean draught of the ship. Fig. 2 represents the block-ship, and A B D C is the half-breadth plan, the sides being vertical, the transverse sections all rectangular, and the keel parallel to the water-line. The sides C D and E F, which form the middle body, are parallel to the keel (or to the centre-line A B), and the half-breadth G C or H D is equal to A C, Fig. 1, the half-breadth of the equivalent rectangular midship-section (which is in fact the midship-section of the block-ship), E L being also equal to A B. The angles C A G and D B H are equal, and while the length A B is equal to the length of the ship, the length A G or H B of the equal wedges which form the ends is such that the area of the figure A C D B F E, multiplied by the mean depth A B is equal to the volume of the displacement of the actual ship.



— Fig. 1.—

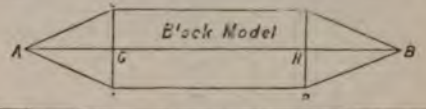


— Fig. 2.—

Complete the rectangle C O P E, as in the dotted lines. It is obvious that the rectangular solid C O P E L Q is equal in volume to that of the block-ship, in fact to the volume of the displacement of the actual ship, and that the length G B in feet $= \frac{\text{Displacement in cubic feet}}{\text{Area of midship-section in square feet}}$, and the mean length of entrance and run A G = length of ship$-\frac{\text{Displacement}}{\text{Midship area.}}$. Also the breadth C E $= \frac{\text{Area of midship-section}}{\text{Mean draught (ex-keel)}}$, and the tangent of the mean half angle of entrance and run C A G $= \frac{\text{G C}}{\text{G A}}$.

Thus from the length, breadth, draught, area of mid-ship-section and displacement, the mean length of entrance and run and the mean angle can be got. There are other methods of working this out, which will occur to any one, but the method given above is perhaps the simplest.

In order to get the length and angle of entrance and run separately (instead of the mean as above), it is necessary to have *in addition*, the displacement in two portions, one forward of the *midship-section, and one aft, the* distance of the midship-section

Reference Number.	Description of Propeller.	Gross Register Tonnage.	Principal Dimensions.			Draught of Water on Trial.			Displacement.		Midship Section.		Area of Immersed Surface.								Immersed Surface of Ship divided by Immersed Surface of Model.
			Length between Perpendiculars.	Breadth Moulded.	Depth Mould'd.	Forward.	Aft.	Mean.	No. Tons.	Co-efficient of Fineness.	Area.	Co-efficient of Fineness.		Length A. B.	Breadth C. E.	Draught forward and aft.	Length of Entrance A.G.	Length of A.C.	Half Angle of Entrance C.A.G.	Area of Immersed Surface.	
			Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.			Sq.Ft.		Sq. Ft.	Ft.	Ft.	Ft.	Ft.	Ft.		Sq. Ft.	
1	SS.	2,811	342 0	38 0	29 11	18 6	20 2	19 4	4,500	·658	643	·92	19.348	329·5	34·8	18·5	84 6	86·4	11° 38′	20,847	·928
2	SS.	"	"	"	"	18 4	19 9	19 0½	4,415	·656	630	·916	19,140	329·5	34·6	18·2	84·2	85·9	11° 37′	20,605	·929
3	SS.	2,911	344 0	39 0	29 11	16 0	20 0	18 0	4,235	·647	604	·907	18,892	331·5	35·3	17·1	86·1	87·9	11° 35′	20,123	·938
4	SS.	2,965	348 0	39 0	29 11	17 3	19 11	18 7	4,472	·653	626	·91	19,506	335·5	35·4	17·7	85·5	87·3	11° 42′	20,854	·935
5	SS.	974	230 0	32 0	19 0	7 0	13 0	10 0	1,227	·625	266	·89	8.552	223·2	28·3	9·4	61·8	63·4	12° 54′	8,824	·969
6	SS.	979	230 0	32 0	19 0	14 9	14 11	14 10	2,034	·683	423	·934	10,850	223·2	29·8	14·2	54·9	56·9	15° 11′	11,468	·946
7	SS.	1,158	240 0	32 0	19 11	11 7	13 8	12 7½	1,693	·647	344	·902	10,216	232·5	28·7	12·0	60·3	62·0	13° 23′	10,604	·963
8	SS.	2,014	285 0	35 0	26 6	13 7	15 10	14 8½	2,710	·685	454	·936	13,947	277·7	32·4	14·0	68·8	70·7	13° 15′	14,650	·952
9	SS.	534	190 0	25 6	15 0	11 7	12 11	12 3	1,115	·694	268	·904	7,300	184·5	22·9	11·7	38·9	40·5	16° 24′	7.726	·945
10	T.S.	...	280 0	60 0	42 6	24 3	25 3	24 9	7.555	·663	1,287	·903	24,021	283·0	54·1	23·8	77·5	82 1	19° 14′	25,026	·96
11	P.	...	203 8	26 6	16 0	10 6	10 6	10 6	885	·581	230	·87	6,700	203 0	23·2	9·9	68·3	69·3	9° 38′	7,185	·932
12	T.S.	...	225 0	30 0	22 6	12 2	13 2	12 8	1,235	·533	285	·79	8,440	220·8	23·7	12·0	69·1	70·1	9° 44′	8,942	·944
13	P.	...	98 0	13 0	8 3	4 9	5 3	5 0	133	·575	785	·87	1,935	97·5	15·5	4·6	32·4	33·3	13° 27′	1,922	·993
14	SS.	2,160	320 0	40 0	21 8 to main dk	8 9	17 4½	13 0¾	2,335	·522	387	·791	13,750	312·0	31·5	12·3	100·8	102·0	8° 53′	14,387	·955

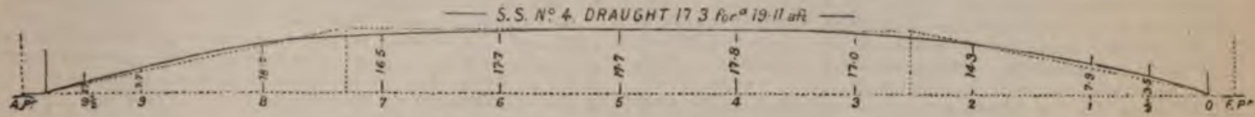
from one end of the ship, and the mean draught of each of these portions; treating them, in fact, as two separate ships, one of which has no run, and one no entrance.

In my earlier attempts I retained the actual breadth of the ship as the breadth of the block-ship and varied the depth, but I prefer the plan given above of using for the block-ship the mean draught of the actual ship. In ships with extremely raking stems or stern-posts, I take the length at half depth when that can be got (or the mean length) as the length of the block-ship. In single-screw steamers, I take the length to the forward stern-post.

The block-ship will often be found of use in forming first or approximate designs, and in this view it may be interesting to compare the wetted skin surface of actual ships with that of the equivalent block-ships, this being an important element in speed calculations and otherwise.

In the foregoing Table I have selected fourteen ships of very diverse types, giving their dimensions, block models, actual wetted surface (exclusive of that of keels or rudder), and wetted surface of block-ships, and the ratio of one to the other.

From this it will be seen that in first approximations, in comparing one ship with another, we shall not commit a grievous error in using the surface of the block-ship, and also that a very close approximation indeed may be made to the actual wetted surface by multiplying the surface of the block-ship by one of the coefficients in the Table, according to the type of ship. In the second column S.S. means single screw, T.S. twin screw, and and P. paddle. In No. 10, I ought to explain, that not only was the rudder of exceptional breadth, but there was a peculiar overhanging portion under water near the top of the stern-post, by which the mean length taken for the block-ship exceeds that of the actual ship between perpendiculars.



To show more clearly the relation of the block model to that of the actual ship, I have selected No. 4 in the above Table, as being a fair example of a merchant mail steamer of considerable speed, and in Fig. 1 I have given the curve of areas of transverse sections; and I have put it in this form, that the ordinates are equal to the half areas of the corresponding transverse sections divided by the draught of water (less depth of keel) at the several sections. This is, in fact, a curve of form, or fineness of model.

Above this, I have drawn the half-breadth plan of the block-ship, the length, breadth, and area of this being of course equal to those of the curve, and the length and angle of entrance and run a mean of those of the actual curve of form.

The discussion was opened by Mr. White, of the Admiralty, who thought that Mr. Kirk's method would be very useful for the mercantile marine, where, he thought he might say fairly, the vessels of high speeds, at least, are very similar to one another in their forms and proportions. He thought its chief value was that it afforded a ready means of approximating to the area of wetted surface. He thought merchant ships had such lengths of entrance and run in proportion to their maximum speeds that, the horse power might be proportioned to the wetted surface. He hoped Mr. Kirk would append to the Table given by him the speed and horse power of the vessels therein contained. He could not help seeing that the method was purely empirical and one to be applied to vessels of approximately similar form and similar type. After advocating an increase of beam in merchant ships, the speaker suggested that if some one would set up an experimental establishment, similar to Mr. Froude's at Chelston Cross, for testing the forms and resistances of merchant ships, it would be found a very profitable investment.

Mr. W. Denny, who followed, agreed with Mr. White that it would be a desirable thing if some one would start such an establishment, and he believed it would have a much larger measure of support than is at present supposed. He did not think Mr. White appreciated Mr. Kirk's analysis as fully as those of the mercantile marine did. He himself had for years wandered about among Admiralty coefficients and the speed formulæ of Professor Rankine, and found himself getting deeper and deeper into difficulty, the work of estimating speeds by those methods being slow and grievously uncertain. He believed the chief elements of resistance were the wetted surface, the length of entrance and run, which at the higher speeds is of absolute importance, and finally the element of fineness. Mr. Kirk's analysis indicates at once, in the first steps of a design, these qualities. He agreed in the desirability of giving merchant steamers more beam, and was now building a vessel similar in all respects to one he had built before, but with 2 ft. more beam. He then referred to another method of estimating speed, introduced by Mr. John Inglis. That method was based upon Mr. Froude's great law of proportional resistances, and was of great service in cases of extreme difficulty. It, like Mr. Kirk's method, required a large background of data. He would repeat what he had often said before, that any gentleman who attempts speed calculations in the mercantile marine, unless he starts from a large and well-arranged, and accurately-obtained mass of experimental data, will be certain, sooner or later, to come to wreck, ruin, and ridicule.

Mr. F. P. Purvis said, since he has been engaged with Mr. Denny's firm at Dumbarton it had been his duty to make use, in several cases of Mr. Kirk's analysis. He said the three elements gained by Mr. Kirk were length of entrance, the angle of entrance, and the area of skin surface. The error in the area of surface was, in fact, only about 4 per cent., which is of little consequence in estimating for horse power, and that could in fact be easily corrected by introducing a factor. He did not see much advantage to be gained from considering the angle of entrance. This conclusion he based upon experiments he had seen made with models by the late Professor Froude. He thought it was not so much the angle of entrance as the coefficient of fineness that governed the resistance. As a means of making the records obtained from this analysis more readily available for use in future ships, he suggested that instead of recording the figures for the actual ships, they should be transformed to represent a similar vessel of a standard size, say 100 ft. long. In this way the actual forms could be compared without the disturbing element of size, and then by Mr. Inglis's method based on Mr. Froude's law of proportional resistances the actual resistance for a ship of any particular size could be obtained. He was inclined to deal with indicated thrust minus the thrust due to initial friction rather than with indicated horse power, or indicated thrust.

Mr. James Hamilton thought Mr. Purvis had made a very valuable suggestion, and that it showed the additional use to which Mr. Kirk's paper might be put. It was chiefly valuable in giving you a means of comparison which you could not otherwise obtain except by a careful study and comparison of the ships line by line. He thought it would be found extremely useful to have the data arranged in this way when they came to fixing upon the power necessary to drive a ship at any given speed.

Mr. Long said in reference to questions of length and breadth that he was now building a steamer 36 ft. long, and 9½ ft. beam, to be used as a lifeboat, and he believed she would be able to go about ten knots an hour, although the beam was proportionally so great.

Mr. Rundell thought Mr. Kirk had given a rough approximation only. The differences in the two columns of areas did not range themselves either in reference to the angle of entrance or to the coefficient of fineness. He then offered some observations upon the use which might be made of the planimeter in calculating the immersed area and the mean angle of entrance.

Mr. Kirk in reply, referring to Mr. White's remark that merchant steamers are all very much alike, said they were often asked to build steamers of speeds for which their forms were utterly unsuitable, and the question of length of entrance amongst other questions often comes up. He approved the suggestion as to the establishment of a place for experimental investigation, at which he thought some points regarding length of entrance and other matters, now but vaguely understood, might be cleared up. He also approved Mr. Purvis's suggestion as to tabulating the results, and thought it would probably in the end save time. In reference to Mr. Rundell's remarks he said the planimeter is an instrument well known both to engine and ship draughtsmen and in frequent use, but he thought from Mr. Rundell's remarks that he had misapprehended the drift of his paper, which was to enable the necessary elements for the speed calculations to be obtained before the lines were got out.

ON SOME RECENT EXPERIMENTS IN ARTIFICIAL COMBUSTION.

By J. F. FLANNERY, Esq., Member.

[Read at the Twenty-first Session of the Institution of Naval Architects, 19th March, 1880.]

IN the first volume of *Naval Science* there is a comprehensive article from the pen of Sir Spencer Robinson, upon the subject of "Coal Consumption in Ships of War;" and after showing the disadvantages that attend the use of Welsh steam coal in the Navy—in some cases a loss of from forty to fifty per cent. by deterioration undergone in Foreign stations—and the great and costly efforts that had been made to improve the furnaces and fuel used, the gallant Admiral concludes with these words: "We are convinced that if the attention of the great body of naval officers be judiciously called to the immense development of efficiency in the Fleet which a well-considered economy in the use of fuel will assuredly bring about, results will be obtained as satisfactory to their professional reputation as they will be conducive to the best interests of the country at large.

There can be no doubt that the Welsh steam coal, or the North Country coal, or any mixtures of these coals, are inferior in economy for the purposes of marine consumption, especially for war ships, to the anthracite, or, as it is sometimes called, "stone coal;" and, although this fact is fully recognized and admitted by naval officers and engineers, it may be useful to recapitulate here the advantages possessed by anthracite coal. According to experiments made by Dr. Frankland, F.C.S., the relative efficiencies of the more prominent Welsh coals in relation to anthracite are as follows:—

	Pounds of Water evaporated per cubic foot of Coal.
Slieverdagh (Irish Anthracite)	618·58
Graigola	581·2
Anthracite (James & Aubrey)	565·02
Duffryn	540·1

Added to the advantages of greater evaporative efficiency, and closer stowage, weight for weight, anthracite coal, by producing no smoke, possesses a valuable qualification for war vessels, as, not only is their position concealed,* but the heating surfaces of the boilers are not so liable to foul; it possesses greater cohesion, and is not so liable to be broken under transport or in a ship's bunkers, and, containing very little sulphur, is not so liable to decay and to spontaneous combustion.

Notwithstanding these qualities the use of anthracite is now almost entirely confined to the drying of malt, it not having come into general consumption as a steam coal because of its slow combustion, demanding great extent of fire-bar surface, and because of its peculiar property of sudden disintegration when put on the fire, causing it, if disturbed, to drop through the fire-bars in small unconsumed particles. If the spaces between the bars are made small enough to avoid this, there is not, under ordinary circumstances sufficient area for the admission of air, and the rate of combustion becomes less than ever. Quoting from a Parliamentary Return of Coal Trials, dated 13th June, 1876, we find (pp. 23) that the relative efficiencies (water evaporated to coal burned) of anthracite (pump quart) and Powell's Duffryn are stated to be 9·43 and 9·44, but the speeds of evaporation are as 18·9 to 24·52; and the Report from Portsmouth Dockyard remarks: "This latter (anthracite) could be burned in a "given boiler with a loss of power of about 20°/o, while the cost would be about 3°/o less;" and again (pp. 22); "It does not appear that it could be used alone if nearly the full power of the boiler in which it is burnt is required, although at slow speeds it might prove economical." The various Reports contained in this Return regarding the comparative efficiency of anthracite for steam purposes are to the same effect.

Some years ago experiments were made at Southampton with a blast passing into a closed ash-pit and *under* the fire-bars to quicken the combustion, but the great heat melted the bars after only a few hours' work.

The idea of promoting the rapid combustion of anthracite and at the same time keeping the fire-bars cool, by means of making the bars hollow and passing the blast *through* them, appears to have originated with Mr. R. W. Perkins, of Swansea, but the system, as developed by this gentleman, was very crude, and unfit for the special conditions necessary for use at sea.

The writer therefore endeavoured to elaborate the system, and, after carefully working out the details and supplying several essential features, submitted it to Messrs. Penn & Sons. With the liberality that has always distinguished this firm, the matter was at once taken up, and Messrs. Penn decided to fit the apparatus to the S.S. *Elephant*, and to make experiments at their own cost. The hollow bar furnace used is shown in the drawings. Fig. 1 is a longitudinal section of the furnace, showing the hollow dead-plate and hollow bridge behind, with the perforated bars supported by them at either end. A is the main blast pipe led from the centrifugal fan and supplying air to the hollow dead-plate B; A^2 branch blast pipe leading to the hollow bridge C; D the hollow perforated bar, which is supplied with blast at both ends from the hollow dead-plate B and bridge C respectively; d, d^1, d^2, d^3, d^4, d^5, d^6, d^7, d^8, d^9, are the perforations in the bar communicating with the spaces between the bars so as to allow the air to pass out freely to quicken the combustion—and it may be here remarked that the fiercer the combustion produced by the blast the cooler is the bar, by reason of the large supply of air passing through. The joints by which the bars are attached to the hollow dead-plate are so arranged as to allow of the free contraction and expansion of the bar without destroying their air-tightness. E is a passage through the hollow bridge to allow air to pass into the combustion chamber.

As anthracite is more liable than other coal to give off partially consumed gas, special arrangements were made for the supplementary mixture of air so as to fully consume those gases. The frame of the fire door F was so made as to communicate with the hollow dead-plate B by the passage *f*, and so distribute a portion of the blast over the fire.

Fig. 2 is a side elevation of the bar; Fig. 3 is a longitudinal section; Fig. 4 is a horizontal section; Fig. 5 a cross-section on line A B; and Fig. 6 a cross-section on line O P.

The boiler of the *Elephant* is of the ordinary cylindrical marine type, and has two furnaces, each 2 feet 10 inches diameter. The starboard furnace was fitted with the hollow-bar furnace with closed ash-pit, and the port furnace was fitted in the ordinary way, so that, being worked alternately, ready comparison could be made of the performance of the new as compared with the ordinary system.

The best Welsh steam coal and the best anthracite were used during the trials.

After some preliminary trials made without recording the results, the first trial officially recorded was made upon the 17th April, 1879, and for the summary of this and ten succeeding trials see p. 32.

The four trials marked "A" were made with the hollow bars having the blast entering at the end nearest the fire-door, but it being found that the lead of the blast-pipe interfered with pricking the fire, alterations were made so as to lead the main blast-pipe clear of the ash-pit, and to separate the blast so that it entered the furnace bars at both ends. Experiment A^1 may there be left out of consideration, although it shows excellent results in point of economy.

Experiments A^2, A^3, A^4 and B^5 were made to compare the working of the ordinary furnace with and without the steam jet with the respective kinds of coal. The results of B^6 are without doubt the most favourable (as regards economy and speed of evaporation combined) obtained during the trials, but the bars were found considerably clinkered at the end of six hours' trial, and the use of the quantity of fresh water (steam at 15 pounds pressure passing through a nozzle 1 inch diameter) necessary to produce the steam blast would be out of the question upon continuous service.

The low economy given by the anthracite in A^2 is owing to the width of the space between the bars, which allowed much partially burnt coal to drop into the ash-pit, the decrepitating property of this coal being well known.

The trials A^3 and A^4 may be taken as the standards for comparison with the hollow-bar furnace of the performance of the ordinary furnace with the respective kinds of coal; observing that the excessive heating surface, in proportion to grate surface caused by using one furnace only, might affect the results of A^3, and the same cause, added to the too wide fire-bar spacing for anthracite, might affect A^4.

Four trials of the hollow-bar furnace after alterations, burning anthracite coal, were made, but B^2 need not be considered, as it was made to test the effect of the fan at different speeds. We may therefore take as a fair statement of the performance of the hollow-bar furnace the mean results of the trials B^1, B^6 and B^7, and these are 25·5 pounds of coal per square foot of grate surface per hour, 8·8 pounds of water, from normal temperature, per pound of coal, and 224 pounds of water per square foot of fire-grate per hour.

It may be here remarked that a column is in the table, showing the economy after deducting the cost of producing the blast; but,

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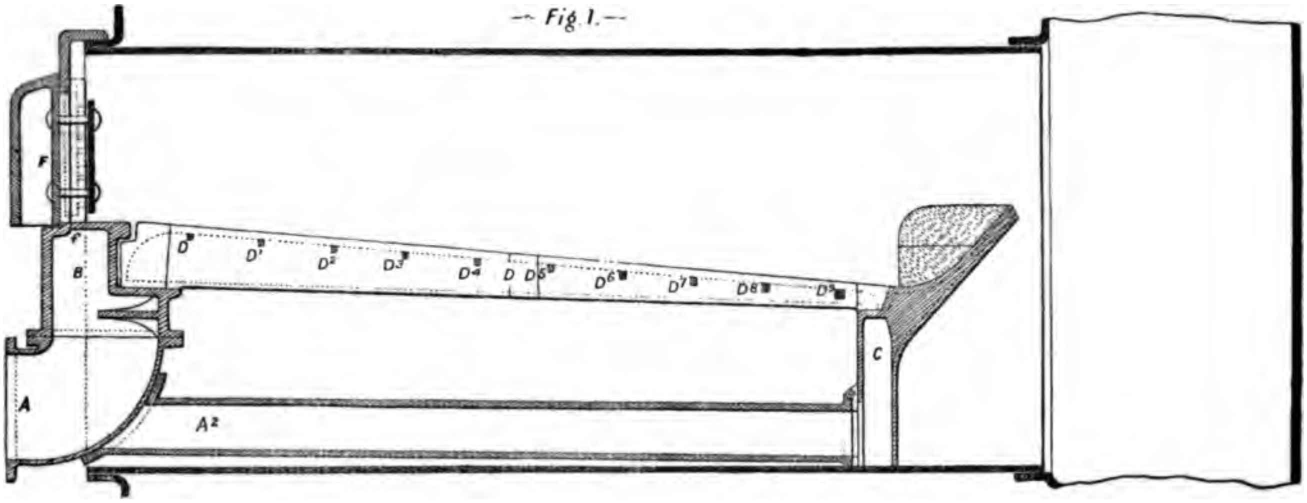
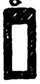
* It will be remembered that the position of the *Huascar*, in the late engagement, was first revealed to the enemy by her smoke, and but for this she might never have been discovered.

ON SOME RECENT EXPERIMENTS IN ARTIFICIAL COMBUSTION.

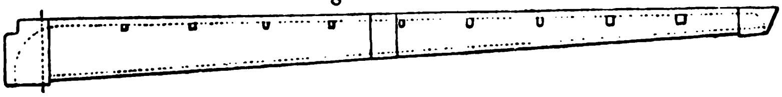
— Fig. 1. —


F
B
A
A²
C
D
D¹
D²
D³
D⁴
D
D⁵
D⁶
D⁷
D⁸
D⁹

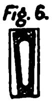
— Fig. 5. —



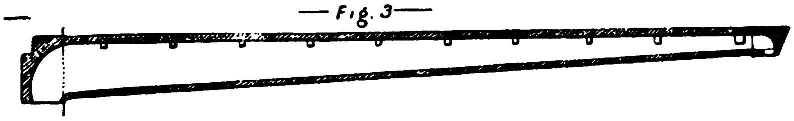
— Fig. 2 —



— Fig. 6. —



— Fig. 3 —



— Fig. 4 —

as the fan and engine used, though quite suitable for an experiment, were not so suitable as though specially made and fitted for the purpose, and therefore not so economical, the figures in this column have not been quoted in the above comparison.

RESULTS OF EXPERIMENTS ON BOARD MESSRS. PENN AND SONS' S.S. "ELEPHANT," WITH ARTIFICIAL DRAFT FURNACE AND ORDINARY FURNACE.

Series.	Series No.	Date.	Description of Furnace.	Description of Coal.	Mean revolutions of Fan per minute.	Coal per Square Foot per hour.	Water per pound of Coal	Water per lb. of Coal including Coal for blast.	Water per Square Foot per hour.	REMARKS.
		1879.				lbs.	lbs.	lbs.	lbs.	
A	1	April 17th	Patent	Anthracite	900	16·47	9·48	8·17	156	Feed temperature 51°.
A	2	,, 18th	Common Furnace with Steam Jet.	ditto	*nil*	24·00	8·15	not known	195	Safety valve loaded to 15 lbs., bars hot and clinkered.
A	3	,, 21st	Common Furnace no Steam Jet.	Welsh Steam	*nil*	18·27	8·9	8·9	163	
A	4	,, 22nd	ditto	Anthracite	*nil*	14·37	8·3	8·3	112	Furnace working with alterations.
B	1	May 6th	Patent	ditto	1,140	25·66	9·1	8·24	233	Progressive trial in two hours' sections.
B	2	,, 7th	ditto	ditto	...	...	...	...	...	Ash pit door open.
B	3	,, 9th	ditto	Welsh Steam	990	20·1	10·25	9·06	206	This trial was eliminated as some doubt was thrown upon the data.
B	4	,, 14th	ditto	ditto	1,250	25·0	9·35	8·46	234	
B	5	,, 19th	Common Furnace with Steam Jet.	ditto	*nil*	30·34	9·0	not known	227	Blast stopped for thirty minutes.
B	6	,, 20th	Patent	Anthracite	1,290	25·74	7·82	7·1	201	Coaled regularly every eight or ten minutes.
B	7	,, 23rd	ditto	ditto	1,280	25·15	9·5	8·6	239	

NOTE.—The furnace not in use was bricked up in the case of each experiment.

Comparing the mean results of the hollow-bar furnace burning anthracite coal with experiments A^3 and A^4, it is seen that there is a gain of $40^\circ/_\circ$ in consumption per foot of fire-grate, as compared with Welsh steam coal, and of $77^\circ/_\circ$ as compared with anthracite on common bars; a gain of $0^\circ/_\circ$ and $6^\circ/_\circ$ in evaporation per pound of coal; and a gain of $37^\circ/_\circ$ and $100^\circ/_\circ$ in evaporation per square foot of fire-grate.

It should be remarked that the bars show very little injury from the tests to which they have been subjected, showing that the passage of blast through them when passed in at both ends of a long bar, or at single ends of bars in two lengths in the same furnace, is sufficient to preserve and keep them cool under a very intense fire, although parts of them were planed down to a little more than $\frac{1}{16}$ inch thick to increase the spacing. Scarcely any ash collected in the interiors of the bars and blast chambers throughout the experiments.

The advantages of a system that will produce results like the above in comparison with the system at present in use are so obvious that it is unnecessary to dwell upon them. It may, however, be remarked that a gain of $40^\circ/_\circ$ in evaporation per square foot of fire grate, without reduced but rather increased economy, is of itself an enormous advantage, tending largely to economy of boiler space and weight on board ship, even after making full allowances for extra heating surface in proportion to grate surface that would be required. If a donkey boiler were used for driving the blast, as would probably be the case in practice on board ship, steam would be raised more quickly than is at present the case. Again, if a given space and weight be available on board ship for boiler and bunker room, by economizing boiler room and weight we increase the number of days' coal that the vessel might carry. For, example, to take the case of a vessel of 3,500 I.H.P., 8 cylindrical boilers, and 300 tons of coal, or say three and a quarter days' full consumption, if we assume this boiler efficiency increased only $25^\circ/_\circ$, we might, with the same weight and space, carry about 380 tons of coal for four days' full power steaming, besides reducing, in some degree, the first cost of the machinery. The features which these experiments went to prove were, not so much the evaporative efficiency of anthracite in point of heat economy, but the speed, combined with economy of evaporation, and the durability of the fire-bars when exposed to the intense local heat of anthracite. The results shown above are, it is thought, extremely encouraging, and go to show that with the system of direct application of the air blast through and around the furnace and through both ends of the bars, great efficiency and economy are secured, and that the only drawback to the use of anthracite coal on board ship has been removed. It would be superfluous to say that this coal should now have very general adoption in H.M. Navy and on board yachts on account of its cleanliness, economy, non-explosive character, absolute smokelessness and strength under transportation, along with the absence of deterioration from evaporation in the Tropics.

Inferior coal could be used with this furnace without reducing the power of boilers, and the present Admiralty policy of promoting the use of Foreign and Colonial coal would be facilitated.

The height of the funnel might be reduced by the use of this furnace; or indeed the funnel in its usual application need not be fitted at all.

Mr. J. Wright, of the Admiralty, opened the discussion, and thought Mr. Flannery had been rather too sanguine in his anticipations as to results that will be obtained. He did not think the experiments had been made on quite a correct basis, and that by having one furnace blocked up while the other furnace was in use he had very nearly twice the usual proportions of heating surface to grate surface, which would be more favourable to the forced blast than to the natural draught. He said every one must be aware that to be able to use smokeless coal in the Navy would be of great advantage, and experiments are being made from time to time to see how far anthracite could be utilized.

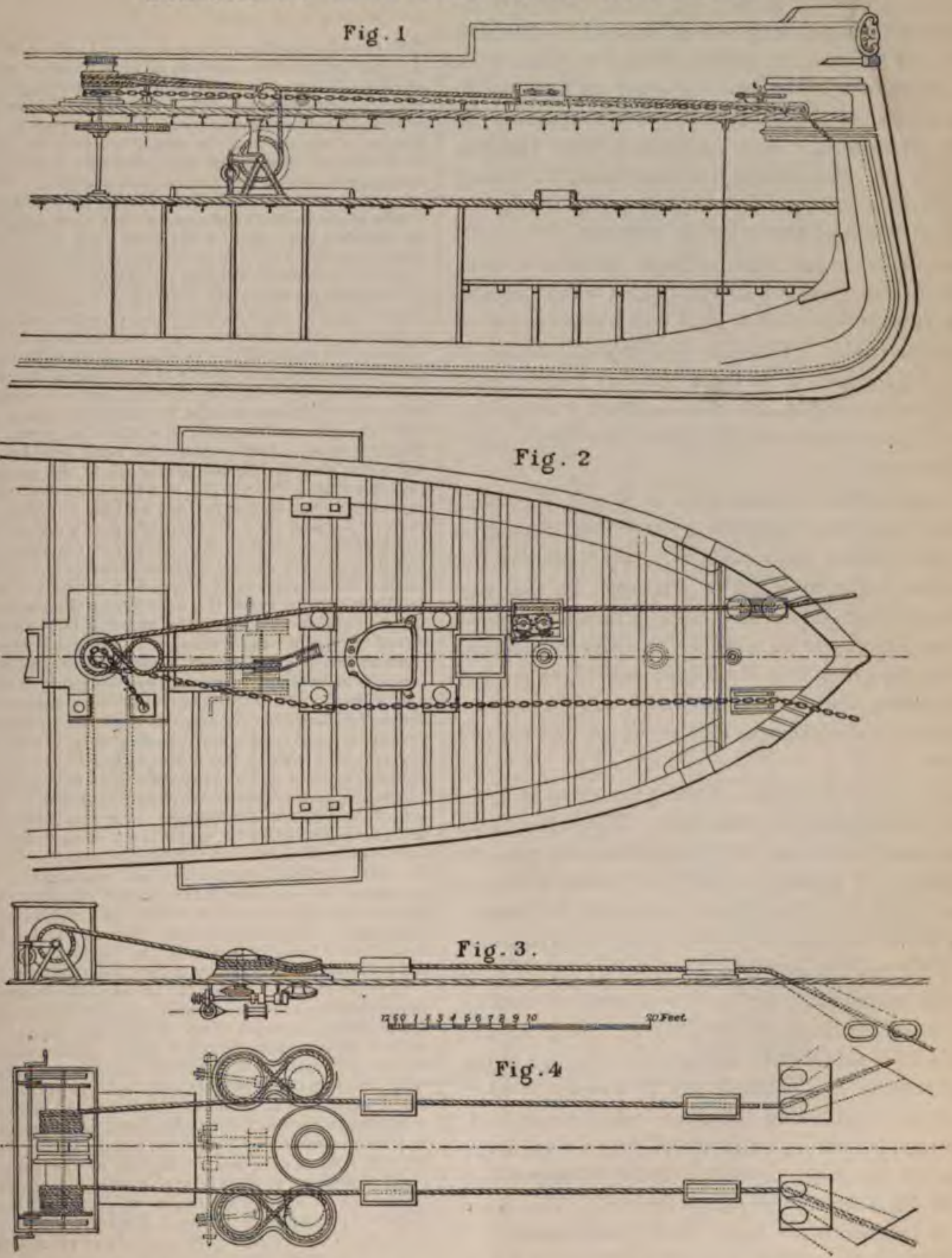
Mr. Perkins gave some particulars to show that the power of anthracite coal is very great when suitably used, but the difficulty was to promote rapid combustion, and that could only be done by increasing the draught. He alluded to means that are adopted for obtaining this object at the smelting works in Wales, where anthracite is used by taking the gases from the mouths of the furnaces as much as 100 yards away so as to economize fuel under the boilers, the atmosphere supplying the oxygen. He had seen anthracite under certain conditions of blast quite equal to the best Welsh coal.

Admiral Selwyn recommended every one to study Professor Rankine's admirable papers on combustion, when they would know the exact amount of oxygen necessary; they would learn that we are far behind in England what has been done in America with anthracite.

Mr. Schönheyder thought the paper was of value in showing that anthracite can be burnt without deteriorating the furnace bars, but beyond that there was nothing shown by it.

Mr. Flannery, in reply, said he was glad to find the worst condemnation Mr. Wright had been able to pass on his paper was that he had been rather too sanguine. He then proceeded to reply to the different points raised, and thanked the meeting for the patience with which they had listened to his paper.

BULLIVANT'S WIRE ROPE CABLE APPARATUS.



BULLIVANT'S WIRE ROPE CABLES.

MESSRS. BULLIVANT & Co., seem to be introducing a great reform in the cable fittings of our commercial marine and navy. For many years, since about 1873, they have been in the habit of supplying their flexible steel cables in lieu of the old-fashioned hemp hawsers. with the best results. We note that a steel towing hawser, supplied in 1874, is still in regular use, and in perfectly good condition. The application, however, of these steel wire hawsers is not nearly as general as it might with advantage be. For instance, should a steam vessel be disabled she has to depend upon the best hawser she has for towing by another steamer which might be able to assist her. The rules of Lloyds, however, only require the largest steamers to carry a 12 inch hemp hawser, which is equal to a breaking strain of only 36 tons, not nearly sufficient to support the violent strains of a heavy sea. It would be little use to increase the size of the hemp hawser so as to render it too unwieldy to handle. With Bullivant's Steel Hawser, however, of the same weight, an attachment for towing may be made equal to a breaking strain of nearly 100 tons, which would be ample for the purpose.

Messrs. Bullivant are, however, now drawing general attention to the great advantages which would accrue from the substitution of their steel wire rope in place of chain anchor cables. There is very little advantage, if any, with a good anchor in the additional weight given by a heavy chain cable, and the weight of a steel wire rope need be only one-seventh of that of a chain cable of equal strength.

The uniformity of strength also of a wire rope with 180 wires must be infinitely greater than that of a linked chain, where any defect in a weld renders the whole cable liable to a sudden fracture. In this way again, there must be much greater protection against sudden and unforeseen parting of the cable in the case of the wire rope in which the fracture would be gradual strand by strand, than in the case of the cable where the fracture when it did occur would be sudden and entirely unforeseen.

The convenience of stowing and paying out is again very much in favour of the wire rope. The rope is kept coiled on a reel in any convenient position, and paid out without danger of kinking or fouling. Cable chains, on the other hand, are proverbially dangerous to handle, and very liable to occasion perilous delay in paying out, or risk of life to those handling it.

Our illustrations show the appliances used for working the wire cable as fitted to Her Majesty's ship *Eclipse*, and to the P. & O. Co.'s ss. *Pekin*. The stowage of the chain is effected in the usual way by passing it as it comes off the capstan into the chain locker in the hold. The wire rope is hove up by means of the grooves on the upper part of the main capstan, and the corresponding grooves of the sister capstan placed forward. This latter capstan is inclined at an angle to the main capstan, so that the wire rope when passed round in a figure of 8 may not chafe against itself, and may work without surging. Automatic nippers hold the rope forward and also in the eyes of the ship.

In the case of the fittings of the ss. *Pekin* the capstans are worked by steam power and are so arranged as to occupy very little deck room. We think from the excellent testimonials upon its use that this wire cable will become very general.

ON SIMPLE AND COMPOUND ENGINES.

II.

IN our last number we gave a general outline of the causes which lead to the actual amount of work done by any given amount of steam, whether in a simple or compound engine, being less than might have been obtained had certain conditions of efficiency been observed, and we pointed out in each case in what respect the compound system had the advantage over the simple engine, and *vice versa*, and stated that the balance with well designed engines remained in favour of the compound engine. We now purpose examining with more detail the various points referred to.

We started with the statement that provided certain conditions of efficiency were fulfilled, the work done by a given quantity of steam, depended only upon its pressure, the rate of expansion, and the back or condenser pressure, and was independent of the number of cylinders in which the expansion was effected, so that simple and compound engines would be of equal efficiency in point of economy. That this is so is not difficult to be seen, since the work done by the steam during admission is equal to the product of its absolute pressure and volume at the point of cut-off, and the work done by the engine against the back pressure is equal to the product of the back pressure and the volume of the steam after expansion; these two items of the amount of the work done being absolutely the same in each case; whilst the work done by the steam during any portion of the expansion is equal to the product of its mean pressure during that portion and the increase of volume during the same time; and since, provided no heat is given to or abstracted from the steam during expansion, and work is done during the whole of the expansion, the pressure at any part of the expansion will depend only upon the volume it occupies, it follows that the work done during any corresponding portions of the expansion will be the same, and hence the work during the whole of the expansion will be equal in the two cases; and the total amount of work got out of the steam will be absolutely identical in the two cases.

If we could draw a curve* showing the relation between the pressure and volume of steam expanding in this way, we should be able to form an indicator diagram showing the amount of work an engine fulfilling the conditions of efficiency above mentioned would perform at each stroke, and by comparing the diagrams of actual engines, both simple and compound, with such a diagram representing the same initial pressure and amount of steam, the relative efficiencies of each could be readily observed. Unfortunately the law of expansion of steam under these conditions is rather complex, and the curve would be different for each initial pressure, but a curve can easily be drawn which represents the pressure and volume of steam *under the supposition that it always remains dry during the expansion*, and this curve will not differ much from the actual curve required, and can very fairly be taken as a standard in the two cases. This curve has been drawn to scale, and published in Rankine's "Treatise on the Steam Engine," and is that shown on the accompanying figure by the plain dotted line.

In order to fully compare the actual performances of a simple and compound engine in the manner we have indicated, we have taken the Indicator diagrams of one of each, and drawn them to the same scale of pressure and volume as shown on the annexed figure, where vertical distances above the lower line represent absolute pressures, while volumes are represented by distances from the left-hand vertical line. The diagrams of the compound engine are from a pair of marine engines with cylinders 36 and 64 inches diameter, working at a steam pressure of 65 lbs. per square inch. As, however, there are very few, if any, marine engines of the simple type working under conditions at all comparable with the compound engine, we have taken as our simple engine diagram one from an engine at Saltaire, published in "Naval Science," vol. iii., page 160, and given as an exceedingly good example of an economical engine.

In the Saltaire engine the steam is cut off by Corliss valves, an arrangement which provides for the cut-off being practically instantaneous, and so preventing most of the wire drawing of the steam during admission, and which allows of very small clearance spaces being used, but which has been tried and found to have so many practical defects, when applied to marine engines, as to prevent its being used. In the compound engine the steam is distributed by means of ordinary slide valves. In comparing these engines we thus see that the Saltaire starts with two great advantages, which could not be obtained in simple engines for marine purposes, in which the clearance spaces would have to be made of at least as great a volume as that in the low pressure cylinder of the compound engine; and we must endeavour to make the proper allowances in the comparison, or we should make the compound engine appear much less efficient than it actually is.

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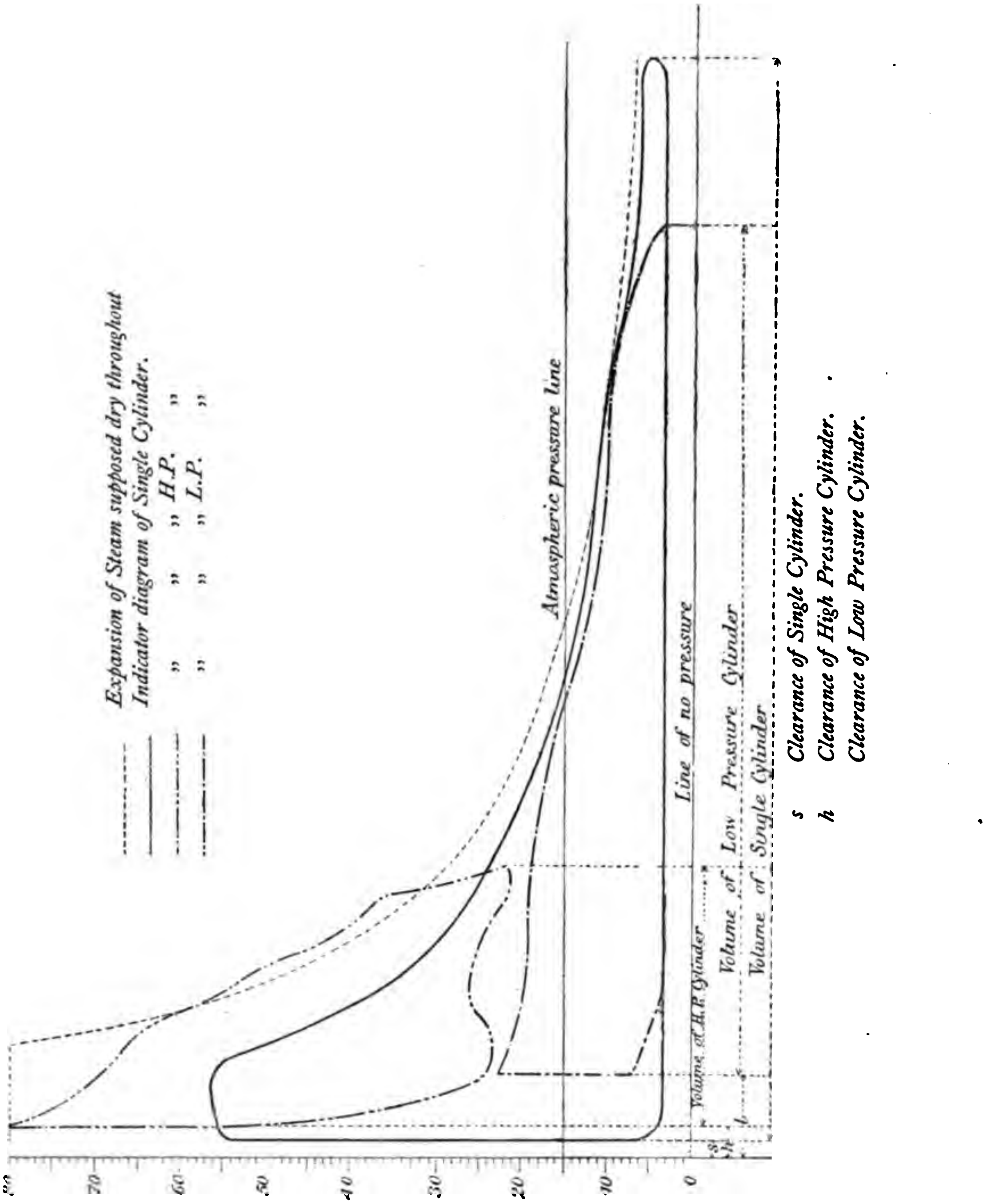
* Called in works on Thermodynamics an "adiabatic curve."



In the Saltaire Engine the steam is expanded to a lower pressure than in the compound engine we have taken, but the scale of volumes has been so taken that the two diagrams shew the same pressure just before the release into the condenser takes place in the marine engine. The expansion line of the steam is drawn through the same point; the three diagrams therefore illustrate the amount of work actually done by the same amount of steam in the simple and compound engines, and that which would have been done had it been possible to expand it under the conditions of efficiency which we take as a standard for comparison. †

It is seen at once what is the influence of the clearance spaces on the work done. In the Saltaire engine the proportion not utilized on this account is only 4 per cent. of the work which would have been done in this engine with the same initial and back pressures under the ideal conditions, while the actual work done is 84 per cent. of the ideal; the remaining 12 per cent. is the amount lost by the condensation of the steam in the cylinder. The great distance between the actual and the ideal steam lines in the diagram at the first part of the stroke shews the very great amount of condensation which must actually take place, while the close approximation of the two lines at the latter portion of the stroke shews that at that part most of the condensed water has been re-evaporated. In this engine, if wesuppose the clearance spaces to be as large as that in the low-pressure cylinder of the compound engine, we should find the loss due to clearance would be increased to 20 per cent., and this would reduce the relative efficiency of this engine to 68 per cent.

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† In the diagram it is seen that the actual steam line for the high pressure cylinder falls above the ideal expansion line, and at first sight it would seem that a greater amount of steam is really used in this compound engine than we have taken. But the fact is that about one-sixth of the steam is at each return stroke compressed in the cylinder and reused at the next stroke, as will be seen by referring to the compression part of the diagram. Allowing for this the steam line would fall altogether inside the ideal steam line as it evidently ought to do

In the compound engine we have the loss of work due to the clearance in the high pressure cylinder about six per cent., and in the low pressure about eight per cent., giving for the two cylinders a total of 14 per cent. of the work which would have been done under the ideal conditions of expansion from the same initial, and with the same back pressure as the compound engine. This compares very favourably with the 20 per cent. which would have been lost in the simple engine with the same amount of clearance. But, in this engine, we have a loss of about 3 per cent., owing to wire-drawing during the entry of the steam into the high pressure cylinder, shewn by the pressure line falling rapidly on the diagram, and which loss would equally have been sustained in a simple engine, and a further loss of about 4 per cent. due to wire-drawing and friction of the steam in its passage from the high pressure cylinder into the low.

The actual work done in this engine is 75 per cent. of the ideal, leaving only 4 per cent. to be accounted for as loss by condensation in the cylinders and imperfect expansion from the high pressure cylinder into the receiver, as against 12 per cent. in the simple engine.

Altogether, we find that although in the actual Saltaire engine 84 per cent. of the ideal amount of work is got out of the steam at 56 lbs. pressure absolute, or 41 lbs. above the atmosphere, yet, with the same pressure and the same amount of expansion in an engine fitted with the ordinary slide valve, the efficiency would not be greater than 65 per cent.; whilst, in the compound engine, working at a pressure 80 lbs. absolute, or 65 lbs above the atmosphere, the efficiency is 75 per cent. of the ideal at that pressure, the relative efficiencies being as 65 to 75, or 15 per cent. in favour of the compound, while, if we consider the extra work got out of the higher pressure steam, which makes the ideal work greater in the case of the compound engine, we have an advantage of at least 33 per cent.

The Compound Engine we have taken is quite of the ordinary type, having nothing special in its design, and working at a pressure of 65 lbs. only. Had it been equally well designed in other respects, and worked at a pressure of 80 or 90 lbs. per square inch, pressures which are now quite common, and which present no practical difficulties in their working, the relative economy would have been much greater. Whilst, if we had taken a simple engine working at only 25 or 30 lbs. pressure, it would, of course, have shewn to much less advantage.

(*To be continued.*)

SAFETY VALVES.

ONE of the most important mountings on a steam boiler is the safety-valve, the use of which is to prevent an undue pressure of steam accumulating in the boiler, and thus to obviate any risk of its explosion from over-pressure.

Considering the importance of having a good and reliable safety-valve, it is not surprising to find that a vast amount of ingenuity has been exercised in producing different forms of valves, for each of which the inventors claim some advantage over all others. We purpose in this article, noticing the general principles which govern the action of safety valves, more especially as fitted to marine boilers.

A safety valve, pure and simple, is a valve the under surface of which is in free communication with the steam in the boiler, and is consequently pressed upwards by the steam with a force proportional to the area of the valve and the pressure of the steam in the boiler. At the same time it is acted upon in the reverse direction by an applied force, termed the *load* on the valve, produced either by means of weights or springs. So long as the pressure of the steam on the valve does not exceed this applied force or load, the valve remains on its seating, but so soon as it exceeds this load, it lifts the valve, permitting an escape for the steam. It thus appears that two conditions must be fulfilled by a *perfect* safety valve; it must be so loaded as to lift exactly at the *pressure to which it is* considered to be safe to work the boiler, and it *must so lift as to provide a sufficient* outlet for all the steam which the boiler can generate without allowing the pressure to accumulate beyond that at which it lifts. A third condition, not necessary for safety, but essential for an economical valve, is that the valve shall close again before so much steam escapes as to lower the pressure below that at which the valve lifts.

In order to fulfil the first condition, viz., that it shall lift exactly at the intended pressure, it is only necessary that the load on it should be exactly equal to that required to balance this pressure, and in a stationary boiler this is very easily obtained by means of direct weights, or by a weighted lever, but in a marine boiler subject to the varied motions of a vessel in a seaway, weights no longer exert a constant force upon the valve. When the valve spindle is inclined at an angle to the vertical, the effective force produced by the weight is equal to the product of the weight into the *cosine* of the angle of inclination. For small angles of inclination the loss of weight from this cause is not great, but it increases very rapidly with the angle (at 30° the loss becomes 13 per cent). The vertical motion of the weights, caused both by the rolling and the pitching of the vessel, also considerably influences their effective force. During the time that the motion is becoming accelerated in an upward direction, the effect of the weight is increased, whilst during the time that the acceleration is downwards, the effect is decreased; in other words, during the time that the downward velocity is becoming lessened, or the upward velocity is being increased, that is, during the latter portion of the downward motion and the early part of the upward motion, the weight will press the valve downward with increased force; whilst during the time that the upward velocity is lessening or the downward velocity is being increased, or during the latter portion of the upward motion and the early part of the downward motion the effect of the weight is diminished, and the valves will permit steam to blow off at less than the desired pressure; and as the vessel, and with it the valves, are generally most inclined at the time when the accelerations of the motion are greatest, the loss of weight due to the inclination must be added to that due to the actual motion. It thus appears that in a marine boiler, during heavy weather, just at the time when probably the full power of the engines is most needed, if the safety valves are loaded by means of weights, the full pressure of steam cannot be maintained.

If we use a spring instead of a weight for producing the load on the value we at once render ourselves independent, both of the inclination and the motion of the vessel, but we at the same time meet with a disadvantage. The spring is made to exert the required force by compressing it (in some forms of valve the spring is stretched), and it is found that the force is exactly proportional to the amount of compression (or extension) which is given to the spring, but in order to cause the valve to lift additional compression (or extension) must be given to it, and it will consequently press upon the valve with increased force; it is, therefore, necessary for the steam pressure to be greater, to lift a spring loaded valve through a given distance, than would be required in the case of a similar but weight loaded valve, the valves in each case commencing to lift at the same pressure.

Now although this is a disadvantage, yet by properly proportioning the length and compression of the spring to the amount of lift required in a valve, this effect can be reduced to a small amount, while it is impossible to keep a steady load at sea by means of weights; it is, therefore, not to be wondered at, that the spring valves are altogether superseding weight loaded valves at sea.

The next condition of a perfect valve is that it shall be capable of being so lifted by the steam, as to allow a sufficient outlet for the escape of all the steam which the boiler can generate, without allowing the pressure to accumulate beyond that at which it first lifts.

The first thing to be noted is that, with the same steam pressures, the size of the opening should be proportioned to the evaporative power of the boiler; and it must be remembered that steam at a high pressure occupies much less space than at a low pressure, besides which it will issue from an orifice with a greater velocity; for both of these reasons a less opening of a valve will suffice to discharge a given quantity of steam at a high pressure than will be required for a low pressure, and therefore the higher the pressure the less is the size of the orifice necessary, other things being the same.* The practice of English marine engineers is, however, to fit the same size valve for any steam pressure, the general rule being to have one square inch area of valve for every two square feet of grate surface, this proportion having been found by experience to provide sufficient outlet for steam at low pressures without any dangerous accumulation, and being accordingly more than sufficient for the high pressures now in general use.

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* The weight of steam discharged per second from an orifice 1 square inch in area is $\frac{P}{70}$ lbs. where P is the absolute pressure in lbs. per square inch, or pressure measured from a perfect vacuum.

In an ordinary valve the area for the discharge of the steam is very much less than the area of the valve, the lift of the valve being always only a small fraction of the diameter, unless the pressure of the steam in the boiler greatly exceeds that at which the valve commences to lift. As soon as the valve has left its seat, the steam issues with a great velocity, and its pressure round the edge of the valve accordingly falls, the greater the velocity of the steam the greater being the reduction of pressure; and therefore the mean pressure on the valve, which is that tending to lift it, must be less than the pressure of steam in the boiler. With a common valve, therefore, there must be an accumulation of pressure over that which first lifts the valve; this accumulation being greater the greater the amount of steam which has to be discharged, and thus a common valve cannot be called a perfect valve.

Valves, however, have been designed and are now in common use which overcome this difficulty. They utilize the escaping steam to help lift the valve by making it act upon additional surfaces, which are usually constructed in the form of an overhanging lip. Of these valves perhaps the simplest in its action is that shown in section in Fig. 1, here the lip is nearly parallel to the upper portion of the seating, and the issuing steam has to be deflected downwards through an angle of about 90°, the reaction due to the deflection of the steam supplying the lifting force necessary to compensate for the loss of pressure under the valve. In other valves, the principle is that illustrated by Fig. 2, the steam first passes at the valve seating A into the annular chamber B, and thence issues through the orifice C into the atmosphere. The steam here not only has its direction deflected downwards, producing a corresponding reaction upwards as in the case illustrated by Fig. 1, but the orifice at C being small, a slight accumulation of pressure occurs in the space B, tending to lift the valve, and together with the reaction makes up for the loss of pressure due to the velocity of the steam.

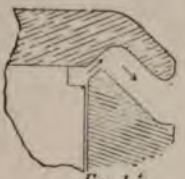


Fig. 1.

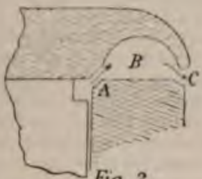


Fig. 2.

In each of these valves the proper proportioning of the lip is a very important point. In figure 1 the farther the lip is from the seat, the less is the downward velocity of the steam, and consequently the less is the lifting pressure, while if the lip is very close to the seat, not only is the velocity and also the reaction of the steam greater, but there will be to a slight degree an accumulation of pressure under the lip similar to what occurs at B in figure 2; and this accumulation will prevent the valve closing until the steam pressure has fallen considerably below the proper loaded pressure. In figure 2 also the proper action depends upon the nice adjustment of the orifice at C. If this is too great, sufficient accumulation of pressure does not take place in B to give the necessary lifting power to the valve, while if it be too small the accumulation becomes too great, and the valve, although lifting well, will not close at the proper pressure. In these valves, especially in those of the form of figure 2, where a smaller alteration in the opening has a greater proportional effect, it becomes of great importance when re-grinding the valves to maintain the proper opening at C, and there is no doubt that the neglect of this precaution is the cause of the complaint often heard of these valves that after being in use for some time they do not close so promptly as when first fitted.

There are other valves in use having different forms of auxiliary lifting surfaces, but the principle of their action is much the same as that described. These forms of valves can be made not only to neutralize the loss of pressure under the valve, but also to counteract the effect of the load increasing in spring valves with the lift of the valve, and hence they can be made to open quite as freely as dead weight valves.

Besides these valves others have been made and used of an annular form, giving a greater discharging area for a given lift of valve, and a given area, but this advantage over the circular form has not been sufficient to bring them into very general use.

OCEAN STEAMERS FOR WAR PURPOSES.

LAST month Mr. Donald Currie, C.M.G., read a paper at the Royal United Service Institution, Whitehall, on "The application of Ocean Steamers to War Purposes." The Marquis of Lansdowne occupied the chair, and amongst those present were the Duke of Northumberland, Lord Ashley, General Sir William Codrington, and Captain Bedford Pim, M.P.

Mr. Donald Currie, in the course of his paper, remarked that it was necessary to take into account a possible war with more than one Naval Power; for although we were at peace, we might, sooner or later, be at war. At the present moment the Russians had in contemplation an increase of their fleet of cruisers; and what did this point to but the destruction of our Commerce in a possible war? The sooner our Commerce became alive to the necessity of helping the Government, and the Government became convinced of the propriety of preconcerted arrangement, the better for England's position. He dared say that one object of getting up the Russian Volunteer Fleet was to frighten the Shipowners and Commercial men of Great Britain, and thereby bring pressure on the British Government in relation to questions of foreign policy. Whatever the special motive was which prompted these proceedings, England was face to face with the necessity of providing against a threatened danger, and the question he wished to discuss was whether there could be any adaptation of ocean steamers to war purposes. Mercantile steamers of sufficient speed would be of great use in time of war. As mail packets their value would be great. The first thing the enemy would do would be to cut our means of telegraphic intercourse, and nothing could be more prejudicial to naval and military operations, dependent perhaps upon instantaneous orders from home, or messages from abroad to the authorities in this country, than a sudden and unexpected stoppage of the means of communication. Swift mail steamers presented the required means of conveying, in time of war, passengers and officers and men to fill up vacancies, and stores and goods. As cruisers employed offensively and defensively, whether to destroy the enemy's commerce or to assist in the protection of our own, a swift, properly constructed, and well adapted Merchant steamer might be usefully and effectively employed. Here speed and strength of construction would be indispensable. As dispatch vessels, swift Merchant steamers, such as the China steam clippers of the day, would be extremely valuable in conveying intelligence for the naval or military authorities between home and foreign ports and our naval stations, or for conveying important communications between the home authorities and officers abroad, or in attendance on a squadron as look-out vessels when off an enemy's port. The service which a Merchant ship might render as a transport was well known. The late war had shown the service such a vessel could render in that capacity. Those Mercantile vessels on the Admiralty List which were capable of a rate not exceeding 10 knots an hour would be useful as transport and store ships, and invaluable as gunboats. The employment of Merchant steamers for war could not do away with the necessity for a full strength in the Royal Navy. There was much misapprehension in the country as to the force in reserve which could be supplied by the Mercantile Marine. Now, there were not 100 ocean steamers connected with this country really suitable for Admiralty requirements, and fit to travel over 12 knots an hour; indeed, he might say there were not 80, and a deduction would have to be made for those vessels which would be out of the way on a declaration of war. In 1878 the First Lord of the Admiralty stated in Parliament that in the event of war, then considered probable, it was intended to fit out 30 Merchant steamers as armed cruisers. But nothing had really been done, and he argued that if something was not done, much information as to the maritime resources of this country would be possessed by foreign Powers, without any advantage to us. He asked whether foreign Governments were to have the choice of our steamers, and to know all our weak points for nothing. He suggested a scheme, and it was that a certain number of capable vessels should be retained by periodical payment for use in the emergency of war. The cost would be trifling, and a splendid fighting power would be added to our resources. He would have it an obligation on the Owners to retain in their employ men connected with the Royal Naval Reserve. He maintained that Government graving docks should be established at every one of the important strategical points of the British Empire. Coaling stations, too, should abound, and they should certainly be fortified. He trusted this question would not be made one of party or would suffer from any economy that would not hesitate to impair the efficiency of the Navy. In conclusion he insisted upon the urgent need of providing for colonial defence.

The conclusion of the paper was attended with applause.

Admiral Sir W. K. Hall remarked that the want of England was a quantity of gunboats.

Sir Spencer Robinson, while agreeing with Mr. Currie in the main, was not sure that an armed Merchant ship was so good for offensive purposes. He concurred with the view that more coaling depots should exist and should be fortified.

Captain Bedford Pim expressed his opinion that the condition of the Mercantile Marine was critical in the extreme, especially as regarded the proportion of foreigners in the mercantile service. If they could reduce the weight of their guns, they might have smaller vessels, which could be built for £9,000 or £10,000 each. He trusted the subject would be threshed out by practical men, and that the country might not be led into an expenditure which was useless.

Mr. Clinton referred to the question of what was the smallest screw steam gun vessel, capable of carrying one long gun, which would be able to master merchant vessels, however large, which were not very heavily armed, unless they were protected by other vessels.

Admiral Hoskins thought that the question of coal depots, docks, and the protection of them, constituted the main question for consideration. As to the employment of large merchant steamers, he thought that, if armed, they would be able to protect themselves against the class of vessels which it had been proposed to send against them.

Captain Long remarked that as to the capacity of merchant ships for self-protection he thought they should see that subsidies given to mail steamers should not be given without regard to this question.

Lord A. Churchill thought it important to provide an admirable type of cruiser. The question of armed merchant ships divided itself into two branches—vessels which were capable of being armed to act on the offensive, and those which, being armed, could carry on legitimate commerce. If the provisions of the treaty of Paris were violated, and we were attacked by those who put privateers into requisition, we should be compelled to do the same.

Admiral Lethbridge considered that, if we went to war, the first thing would be the destruction of the Suez Canal, so that we must not look for a passage that way; but must turn attention to the passage round the Cape of Good Hope. The question was, whether we should not have a flotilla there ready to act in defence of our commerce. That touched on the coal and dock question. He would also suggest Sierra Leone as a coaling station; while Barbadoes might be elected on the opposite side of the sea.

Admiral Selwyn remarked that the merchant steamers were calculated to play the part of running away, and that was their business. The instant the merchant steamer fired a gun, she provoked attack. There was the much wider question of how we should provide corn and feed our people without these merchant steamers? In the present state of maritime warfare one cruiser would create a scare. They had experience of how the American carrying trade had suffered in two years during the civil war. The merchant steamer would do best if it continued its work. We should press forward constant experimental research, and what was wanted was to secure the last development of science. It was desirable to have a Council appointed, before which every new project might be presented, to receive the good and reject the bad.

The Marquis of Lansdowne thought that there was apathy on the part of the English public with reference to this question, and it was desirable that closer attention should be paid to the subject. Our responsibilities were not diminishing, and as to our resources there were one or two points of weakness. One was the comparatively small number of cruising vessels, and there was also the fact that our ironclads were liable to get out of order. The question of men and officers was a serious one.

Mr. D. Currie replied, and urged that there should be a large supply of the best Government cruisers in the service of the country. A vote of thanks was passed to Mr. D. Currie for his lecture, *and was briefly acknow*ledged by him.

TORPEDO BOATS.

A VERY important improvement has, with the approval of the torpedo authorities at Portsmouth, Captain Gordon and Commander Wilson, of the *Vernon*, been introduced by Messrs. Yarrow & Co., of Poplar, into the second-class torpedo boats which they are building for the Admiralty. Hitherto the designers and constructors of these craft have been in the habit of simply supplying the boats with their engines, leaving the various Governments to fit the torpedo gear in any way they thought best. In many cases the work was badly done, and in any case the hulls were very much cut about and injured. No sooner was a boat received from the contractors than measures were at once taken by the dockyard hands to alter the position of the funnels, remove a bulkhead, or carry out some structural alteration with a view of facilitating the storing and launching of the fish torpedo. In the *Lightning* it was attempted to discharge the projectile from the bows by means of a pneumatic tube, while in the second-class boats the torpedo is discharged from swinging cradles or skeleton tubes amidships. Both plans are open to grave objections. In the first the men are wholly unprotected from the fire of an enemy; while in the other case it is necessary to arrest the progress of the boat before the run can be made. The cradles are slung in davits at the side, and so arranged that they can be easily lowered below the surface of the water. When the projectile is completely immersed it is allowed to pass out of the tube by its own propelling power, taking a direction parallel to the boat itself. Very excellent practice has been made with this plan, which is the one in general use on board torpedo boats in the English navy; but as considerable loss of time must ensue in lowering and starting the *Whitehead*, and this perhaps at a critical moment, the plan is attended with serious drawbacks. In the craft which the Messrs. Yarrow are now supplying to the navy the necessities of torpedo management are taken into account in the original design, and the boats are furnished to the Admiralty complete and ready for service, with all the torpedo gear and equipment fitted on board. In these the old method of lowering and discharging the *Whitehead* from a cradle at the side has been dispensed with. The new plan consists in building into the forward part of the boat two troughs, or half tubes parallel to each other, in which the two torpedoes, comprising the armament of the craft, lie ready for use. Immediately behind, and protected by a turtle shield, are a couple of impulse tubes of the ordinary piston-rod type, and which can be worked either by steam or compressed air, though in the English service the latter power has been exclusively adopted. These tubes are so arranged that at the will of the officer in charge either one or both torpedoes can be instantaneously ejected without causing any loss of speed to the boat or necessitating the presence of any of the crew on deck. The boats are provided with two funnels abreast, but well apart, so as to allow of a clear space in the middle of the deck, and the rear of each craft is protected by a swivel gun.

Messrs. Yarrow are also constructing a large torpedo boat for the Russian Government, which will be capable of steaming from the Thames to St. Petersburg. It is built after the model of what is known as the "Yarrow" type, being fitted with two funnels and a curved deck, and is provided with a modification of the plan for fighting the *Whitehead* already described. It measures 100 ft. in length by 12½ ft. in beam, and is propelled by a two-bladed screw, the shaft of which passes below the rudder, which is pivotted upon the propeller tube. This plan will secure the boat great rudder leverage; but in order to enable the boat to turn in her own length, and increase her manœuvring power at full speed, she is also provided with an auxiliary drop rudder forward, which can be worked in conjunction with the aft rudder. Her armament consists of six Whitehead torpedoes (two being in the guns ready for firing) of the ordinary 14-in. character, four of the Russian type, which are much larger than those employed in the English service. These are fired from two torpedo guns, or impulse tubes, built into the boat forward, and covered by a turtle-back deck, which not only protects the gear, but adds considerably to the seaworthiness of the craft. This turtle deck is raised at the after end and slants forward to the level of the deck. The conning tower, whence the torpedoes are fought and the boat is steered, is immediately at the rear of the turtle, and has thus an unobstructed view. Boats of this new and formidable character are considered to possess much more offensive power than those of the *Lightning* type, which are only provided with one torpedo ready for use, and a couple of spare ones, and in which the projectile and the discharging apparatus are in a most exposed position.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Helen Newton.—On the 25th March, there was launched from the shipbuilding yard of Mr. Robert Thompson, Southwick, Sunderland, an iron screw steamer, of the following dimensions, viz.:—Length, 240 ft.; breadth, 32 ft.; depth, 17 ft.; about 1,300 tons gross. The vessel has been built to the order of Messrs. Newton Bros., Hull, under special survey to class 100 A 1. She is constructed on the two-decked rule; has a full poop extending 30 ft. past amidships, with large galley and chart-house, and accommodation for Engineers; also full topgallant forecastle for the accommodation of crew, the cabin being fitted up aft for the accommodation of captain and officers, in the usual style. She is schooner-rigged, has iron lower masts, three steam winches, patent windlass, and patent midship steering apparatus; has four cargo hatches and water ballast, together with all the most recent improvements. The engines are on the compound direct acting surface condensing principle, with cylinders 28 by 54 by 33 stroke, by Messrs. Blair & Co., Stockton-on-Tees. On leaving the ways she was named the ***Helen Newton*** by Miss Emmie Newton, sister of the owners.

Titania.—On the 25 March, Messrs. Raylton, Dixon & Co. launched from their Cleveland Dockyard an iron screw steamer, built to the order of Messrs. C. T. Bowring & Co., of Liverpool and London, and specially constructed for the Atlantic trade, being strengthened in excess of Lloyd's Rules, with large carrying capacity, and in every way fitted for this important branch of trade. The vessel is 275 ft. long by 35 ft. beam, by 24 ft. 6 in. depth of hold, and of a gross tonnage of about 2,000 tons. She has main and upper decks of iron, sheathed with timber; water ballast in after hold and engine-room, and in large chamber in forehold; has four steam winches, and every convenience for rapid loading and discharging of cargo; has steam steering gear on the bridge, and protection for steering gear aft. Accommodation for captain and officers is placed amidships under the bridge. She will be engined by Messrs. Thomas Richardson and Sons, of Hartlepool, with engines of 170-horse power nominal. On leaving the ways she was christened the *Titania* by Miss Pennyman, of Ormesby-hall.

Charles Quint.—On March 25 there was launched from Messrs. A. and J. Inglis's shipyard at Pointhouse, the first of a fleet of 10 steamers ordered by the Compagne Generale Transatlantique for the new postal service between Marseilles and Algiers. She is of the following dimensions:—313 ft. 6 in. by 33 ft. 6 in. by 25 ft., and will be fitted by the builders with engines of 2,000 indicated horse-power. The vessel was named *Charles Quint* by Miss Agnes Gebbie, Strathaven.

Canton.—On March 27 the Canton was launched from the Neptune Works of Wigham Richardson & Co., at Low Walker, and christened by Mrs. Jaques. She is 290 ft. long over all by 54 ft. beam, teak spar deck, and engines of 1,000 to 1,100 indicated power. She is intended for a special service in the East requiring a speed of 11 knots. She will carry 2,000 tons of deadweight on a very light draught, and nearly 3,000 tons of measurement cargo. Her engines, of the builder's own make, are nearly the same, but of reduced size, as the *Messagerie's* engines, which are erected alongside in the same erecting shop. The tubes of the condenser are held with contracted screwed ferrules, the circulating pump is double-acting, the starting gear, and also the turning gear, are worked by steam-power, and the boilers are of ample size, and made throughout of steel. The *Canton* is to be commanded by Capt. J. C. Jaques, to whose order she has been built, but the owners (with the exception of a few shares allotted to Newcastle) are a few gentlemen of influence in London and Glasgow.

Stranton.—On the 30th March Messrs. W. Gray & Co. launched from their yard at West Hartlepool an iron screw steamer, built to the order of the West Hartlepool Steam Navigation Company. Her dimensions are:—Length between perpendiculars, 256 ft. 6 in.; extreme breadth 34 ft. 6 in.; and depth of holds, 19 ft. 8 in. and 24 ft. 3 in. Gross tonnage, 1,760 tons, and will carry a deadweight of 2,350 tons. Classified 100 A1 at Lloyd's, and built under the special survey of Captain G. Wright. Engines, 150-horse power, by Messrs. T. Richardson & Sons, of the Middleton Ironworks, Hartlepool. As the screw-steamer left the ways she was christened the *Stranton* by Mrs. Barraclough, of West Hartlepool.

Alverton.—On April 10, Messrs. Edward Whitey & Co. launched from the Middleton Shipyard, West Hartlepool, an iron screw steamer built to the order of Messrs. Middleton & Co., West Hartlepool. This vessel has large capacity both for deadweight and measurement cargoes, and is intended for the Indian, Transatlantic, and Mediterranean trades. Her principal dimensions are:—Length b.p., 240 ft.; beam extreme, 33 ft.; depth of hold to Lloyd's height of floor plates, 18 feet. She has a double bottom all fore and aft on the longitudinal and bracket system, and has been built under Lloyd's special survey for the 100 A 1 class. She has topgallant forecastle, long full poop, and bridge-house joined; Napier's patent steam capstan windlass; the chart-house, engine-room, skylight, rails and decks are of iron, and she will be rigged as a topsail schooner; her engines, of 120 h.p., and her boiler, which is of steel, will be fitted by Mr. George Clark, Sunderland. As the steamer left the ways she was christened *Alverton* by Miss Charlotte Tristram, daughter of the Rev. Craven Tristram, F.R.S., of Durham.

Villa d'Oran.—On April 10 Messrs. Wigham Richardson & Co., Neptune Shipyard, Low Walker, launched a vessel intended for the Compagnie Générale Transatlantique of Paris, and named *Villa d'Oran.* She is one of the 13 to be built in this country for the same owners, Messrs. Richardson having another of exactly the same size and dimensions well forward on the stocks at present. Four are being built by Messrs. Elder & Co., of Glasgow, two by Messrs Inglis, Glasgow, two by Messrs. Caird, Greenock, and three others of a smaller size are being built by other builders on the Clyde. The ceremony of christening the *Villa d'Oran* was performed by Miss Herbert, daughter of the Rev. S. A. Herbert, vicar of St. Cuthbert, Gateshead. The ship's dimensions are 320 feet long, 33½ ft. breadth, and 25¼ ft. depth. Her tonnage will exceed 2,000 tons, and her engine power will be capable of working up to 2,000 horse power, and with such engines it is expected that she will make, when fully laden, 14 knots an hour. The engines are well forward, and are being made by Messrs. Wigham Richardson & Co. in the same yard. The vessel is one of the largest passenger ships ever built on the Tyne. The *Villa d'Oran* will trade between Marseilles and Algiers, and will carry the postal service between the two countries. She will carry fully 200 first-class passengers.

Cyclops.—On the 22nd of April, Messrs. Scott & Co., Shipbuilders, launched from their shipbuilding-yard at Cartsdyke, a screw steamer of the following dimensions:—Length, 320 ft.; breadth, 43 ft.; and of about 2,301 tons burthen, with engines of 300 horse power. She has been built to the order of Messrs. Alfred Holt & Co., Liverpool, for their China trade, and is sister steamer to the *Laertes*, which was recently built and fitted out for sea by the Messrs. Scott. On leaving the ways the new steamer was named the *Cyclops*, and was afterwards towed down to the Victoria Harbour and put under the large steam crane to have her machinery put on board.

Brantford City.—On the 29th March, at West Hartlepool, Messrs. W. Gray & Co. launched from their yard an iron screw steamer, built specially for the American cattle and provision trade, to the order of Messrs. T. Furness & Co., of the same town. The vessel was named the *Brantford City*, after the American depot of her owners, Messrs. Furness & Co., the christening ceremony being performed by Mrs. Bell, wife of the member for the Hartlepools.

LAUNCHES.—SCOTCH.

Prins Hendrik.—On the 25th March, Messrs. John Elder & Co. launched from their shipbuilding-yard at Govan a paddle steamer called the *Prins Hendrik*, intended to augment the fleet of the Zealand Company trading between Flushing and Queenborough. The dimensions of the vessel are:—Length, over all, 300 ft.; breadth of beam, 35 ft.; depth (moulded), 24 ft. 3 in. Her gross tonnage is 1,652, and the engines, which are nearly completed in the yard, are 600-horse power nominal, and constructed on the Builders' compound oscillating principle, with all the newest adaptations. The internal fittings of the vessel will be of the most complete description, with accommodation for 150 first and 40 second-class passengers. The *Prins Hendrik* is a sister vessel to the *Prinses Marie* and *Prinses Elizabeth*, built by the same firm. As the vessel left the ways the naming ceremony was performed by Mrs. Raalte.

Soto.—On the 27th March, Messrs. Napier, Shanks, & Bell, launched at Yoker an awning-decked steamer of about 950 tons, being the first of two constructed to the order of Robert M'Andrew & Co., London, for Messrs. J. Roca & Co., Barcelona. This firm already possess a fleet of nearly 30 steamers, to which the new vessels built by Messrs. Napier, Shanks, & Bell will form an addition, being adapted throughout to the special requirements of their trade. On leaving the ways the vessel was named the *Soto* by Miss Napier of Blythswood-square, Glasgow.

Vanadis.—On the 27th March, Messrs. Ramage & Ferguson launched a steam yacht, of 300 tons measurement, the property of Messrs. Hankey & M'Iver, of London and Liverpool, She will have compound engines of 60-horse power by Messrs. Walker, Henderson & Co., Glasgow, a steam windlass by Napier Bros., and steam steering gear by J. H. Wilson & Co. The ceremony of naming the vessel *Vanadis* was performed by Miss Connie Williamson, Edinburgh.

Ivanhoe.—On March 29th, Messrs. H. M'Intyre & Co. launched from their shipbuilding yard at Paisley, the Ivanhoe. an iron screw steamer of 250 tons, built to the order of Messrs. Wm. M'Lachlan & Co., fish salesmen, Glasgow, and intended for their herring trade. The vessel will be fitted with compound self-condensing engines of 300 effective horse-power. The ceremony of naming was performed by Miss Annie Harvey, Edinburgh.

Vincenzo Florio.—On March 29 Messrs. Alex. Stephen & Sons launched from their yard at Linthouse a mail steamer of about 3,000 tons, constructed under special survey to the highest class in Lloyd's, and fitted, before launching, with compound surface-condensing engines of 370-horse power nominal. This steamer has been built for Messrs.I. & V. Florio & Co., of Palermo, and was named the *Vincenzo Florio*, after the founder of that firm, Miss Stephen performing the ceremony. The *Vincenzo Florio* has first and second class passenger accommodation, provision for water ballast in double bottom on bracket principle, and throughout her whole fittings and arrangements the most modern improvements are introduced.

Mirimar.—On March 29, Messrs. Murdoch & Murray launched from their shipbuilding yard at Port Glasgow, an iron screw steamer named the *Mirimar.* The following are her dimensions:—230 by 21 by 31, 1,200 tons gross. This vessel has been built to the order of Messrs, Raeburn & Virrel, Glasgow, and will be furnished with compound engines of 130-horse power by Messrs, Kincaid, Donald, & Co., Greenock.

Harley.—On March 30 Messrs. Russell & Co. launched at Port Glasgow a steamer of the following dimensions:—Length, 170 ft.; breadth of beam, 24 ft.; depth of hold, 12 ft.; to be classed 100 A 1, and fitted with an iron deck and water ballast, built specially strong to carry 500 tons in light ballast. This steamer is fitted with steam winches for quick discharge of cargo. She has been specially designed and built for the coal trade between Newport (Mon.) and Cork, having long hatches and clear holes, enabling her to carry the soft Newport red-ash house coal used at Cork, free from small. She is the property of Messrs. James Harley & Co., Cork. The vessel is named the *Harley*, and will be engined by Messrs. Walker, Henderson & Co., Glasgow.

Moise.—On April 12 Messrs. John Elder & Co. launched the first of four steamships they are building for the Compagnie Générale Transatlantique. She was named the *Moise* by Mrs. Charles Henderson, and is a vessel of 1,850 tons. Her dimensions are 313½ ft. in length between perpendiculars, 33½ beam, and 25½ ft. depth, moulded. The engines, which indicate 2,400-horse power, are on the compound principle, inverted cylinders, and surface condensers, and steam is supplied by two circular double-ended boilers. The speed expected is 14 knots per hour. She will be fitted with accommodation for 60 first-class, 40 second-class, and 60 third-class passengers. The *Moise* is schooner-rigged, with pole masts of iron, and she will carry four lifeboats and two gigs.

Mercader.—On the 10th April the *Mercader*, a screw-steamer measuring about 70 tons, was launched at Leith by Messrs. D. Allan & Co. She is built expressly for trawling purposes for Messrs. Mercader & Son, of San Sebastian.

Vigilant.—On April 21 Messrs. Murdoch & Murray launched at Port Glasgow, the third of four screw steamers being constructed for the Great Northern Fish Carrying Company. The steamer is named the *Vigilant*, and is of the following dimensions:—Length, 130 ft.; breadth of beam, 21 ft.; depth of hold, 11 ft. The engines are supplied by Messrs. Muir & Houston, Glasgow. The *Vigilant* was at once towed up to Glasgow.

Chancellor.—On April 21 a saloon paddle steamer, the most *recent addition to the fleet* of the Lochlomond and Lochlong Steamboat Company, and intended for their Helensburgh and Arrochar traffic, was launched from the shipbuilding yard of Mr. Robert Chambers, jun., Dunbarton. The vessel, which is built of steel, is of the following dimensions:—Length, 208 ft.; breadth, 21 ft.; depth, 7 ft. 7 in. As the vessel moved off the stocks she was christened the *Chancellor* by Mrs. Colonel Coquhoun, of Ben Cruach Lodge, Arrochar. It is expected that the new *Chancellor* will be ready for her station at the beginning of the season.

Vanduara.—On March 30 there was launched from the shipbuilding-yard of Messrs. D. & W. Henderson & Co., on the Clyde, a cutter yacht of 90 tons, which has been built for Mr. John Clark, of Gateside, Paisley. As the vessel moved on the ways she was named *Vanduara* by Miss Clara Clark, niece of the owner. Although intended for racing, the *Vanduara* is also a model cruiser, comfort, safety, and strength being in no instance sacrificed for speed, being classed 100 A 1 at Lloyd's.

Elcano.—On the 30th March the new steamer *Elcano*, of about 1,000 tons was launched from the dockyard of Messrs. A. M'Millan & Son, of Dumbarton. This vessel has been built to the order of Messrs. Olano Larrinaga & Co., of Barcelona and Manilla, for trading between these two ports, and is in all respects a duplicate of the *Jorge Juan*, which Messrs. M'Millan launched a few weeks ago for the same owners. Mr. Rowan, of Glasgow, is supplying both vessels with engines, having cylinders 29 in. and 56 in., with a piston stroke of three feet, the first of which is now almost completed. The naming ceremony was performed by Mr. Richard de Longa, son of one of the principal owners.

Diana.—On the 6th April Messrs. Charles Connel & Co. launched, at Scotstoun, the *Diana*, an iron sailing barque of 750 tons, built to the highest class at Lloyd's. This vessel is a duplicate of the *Comus*, built by the same firm in the middle of last year for Messrs. Barton & Co., merchants, Glasgow. Immediately after the launch she was towed to her berth to be loaded by Messrs. Thomas Skinner & Co., for Singapore and Penang.

Allan Macdonald.—On April 9, the Campbeltown Ship-building Company launched a steamer for the Salt Works Company. The vessel measures 119 ft. by 19 ft. 9 in. by 9 ft., and carries 260 tons. The engines were fitted up by Messrs. Ross & Duncan, Glasgow. The steamer was named the *Allan Macdonald*, of Newry, by Miss Maggie Macnair, Braefoot.

LAUNCHES.—Irish.

Winnebah.—On March 29th, a screw steamer of about 3,000 tons register was launched from the ship-building-yard of Messrs. Harland & Wolff, Queen's Island, Belfast. She is called the *Winnebah*, and is built to the order of the South African Steamship Company, and will be placed in that trade in conjunction with the fleet of ships belonging to the same company, some of which have been constructed on the Queen's Island. As the *Winnebah* was leaving the launchways, through some misadventure one of the plates in her bottom received injury by coming in contact with, it is thought, a bar of angle-iron which had been projecting unobserved from the slip.

TRIAL TRIPS.

The Corebo III.—The new Italian steamer *Corebo III.*, which was launched some weeks ago from the dockyard of Messrs. A. M'Millan & Son, went down the Clyde on March 26 for a trial of her engines. She had 1,000 tons dead weight on board, with which her draught in salt water was 10 ft. 11 in. mean. Her engines are compound direct-acting, having cylinders 26 in. and 47 in. with a piston stroke of 3 ft., and have been constructed by Messrs. M. Paul & Co., Dumbarton. The speed on the mile was 10·287 knots, which was considered by Messrs. M'Millan, the contractors, in every way satisfactory. The *Corebo III.* has been built by Messrs. M'Millan to the order of Signor Piaggio, of Genoa, and as the builders have undertaken the delivery of this vessel in Italy, she goes there immediately after adjusting her compasses, under the charge of Captain Greig, of Glasgow.

The Lismore.—The new screw steamer *Lismore*, recently launched by Messrs. Gourlay, Brothers & Co., for Messrs. G. and B. Nicoll, of Sydney, New South Wales, proceeded down the river from Dundee on the 30th March to test the efficiency of her engines. The result was most satisfactory, scarcely any vibration being experienced, the measured mile being passed three times, giving a mean speed of 10 knots per hour. The *Lismore* is a steamer of about 400 tons d. w. capacity, and has a saloon amidships fitted up for passengers with all modern appliances. She is the fourth steamer which has been built by the Messrs. Gourlay for Messrs. G. & B. Nicoll for their Coasting Trade in New South Wales.

The Kameruka.—On March 30 this twin screw steamer, which was recently launched by Messrs. Russell & Co., of Greenock, for the Illawarra Steam Navigation Company, of Sydney, had a preliminary trial previous to leaving the Clyde for the Antipodes. The *Kameruka* is the first steel-built steamer launched at Greenock, and has been constructed to meet the special requirements of the traffic on the Australian coast, embracing as she does light draught of water, great carrying capacity, high rate of speed, with a moderate consumption of fuel. Her engines, which have been supplied by Messrs. Rankine & Blackmore, Eagle Foundry, Greenock, are double, with a nominal power equal to about 90 horse. At the official trial yesterday a speed slightly over 12 knots was easily obtained, and this was declared to be satisfactory by Mr. Manning, the managing director of the company, from Sydney. The engines worked with great smoothness, and the performance of the steamer throughout the trial was recognized as being highly successful.

The Gironde et Garonne.—The trial trip of the new paddle steamer, *Gironde et Garonne*, which was recently launched from the shipbuilding yard of Messrs. H. M'Intyre & Co. Paisley, took place during last month. The steamer has been built on similar lines to the *Rothesay Castle*, which formerly plied between Ardrossan and Arran, and she is intended as a sister steamer to that vessel. The *Rothesay Castle* was last year purchased from Captain William Buchanan by the Cie Maritime Gironde et Garonne of Bordeaux, and the *Gironde et Garonne* has been built to the order of the same company, and is intended for the traffic on the River Gironde in the south of France. In style she is very much like the Clyde river steamers, and her fittings are on entirely the same principle. She is 200 ft. in length, 21 ft. broad, and 7 ft. 9 in. deep. She has been engined by Messrs. Hutson & Corbett, Kelvinhaugh Engine Works, Glasgow, with a single direct acting steeple engine of 120 horse power, which on Saturday worked to the entire satisfaction of all concerned. The weather for the trial trip was very fine. The vessel immediately proceeded down Channel, and ran the distance between the Cloch and the Cumbrae Lights both going and returning, and her speed proved to be at the rate of fully 16 knots an hour, which was deemed highly satisfactory.

The Lord Jeffrey.—On April 5th this vessel, built by the Tyne Iron Shipbuilding Company, Willington Quay, on Tyne, and engined by Messrs. R. & W. Hawthorn, of Newcastle-on-Tyne, for the firm of Messrs. Charles Tully & Co., had a successful trial. The vessel, whose dimensions are 270 ft. by 35 ft. by 24 ft. 6 in., realized a mean speed of 11·1 knots per hour. The engines have cylinders of 62 in. and 32 in. diameter and 40 in. stroke. With a steam pressure of 90 lbs. they developed 1,020 ind. h.p. The engines are the first that have been fitted with Mr. F. C. Marshall's "patent slide valve gear," which, owing to its simplicity and novelty, excited considerable interest; its working was perfect, and gave every satisfaction. She is fitted for general trades, having Messrs. Donkin & Nichol's patent steam steering gear, and all modern appliances, and is to be employed at the present time by the West African Steam Navigation Company.

The Jorge Juan.—The new Spanish Steamer *Jorge Juan*, which was lately launched by Messrs. A. M'Millan & Son, Dumbarton, for Messrs. Olano, Larrinaga & Co., of Barcelona, went down the Clyde on the 15th of April for a trial of her engines. The principal dimensions of this vessel are :—Length, 220 ft.; breadth, 30 ft.; depth, 18 ft. She has been fitted by Mr. Rowan, of Glasgow, with engines having cylinders 29 in. and 56 in. with a stroke of three ft. The trial was in every way satisfactory, everything having worked with the greatest smoothness. The *Jorge Juan* is fitted up for about 30 first-class passengers.

Progress.—On the 17th of April the screw steamer *Progress*, launched at Grennock for the Great Northern Fish Carrying Company by Messrs. Murdoch & Murray recently, went down the Clyde on a trial trip. This is the second of four boats for the same company. The rate of speed attained by the *Onward*, the first of the order, was somewhere about 14 knots, and it is expected that the whole of the boats will be very speedy.

Trojan.—On the 22nd April the Union Steamship Company's new Royal Mail steamer *Trojan*, of 3,600 tons burthen and 3,400 horse power, which has just been completed by Messrs. J. & G. Thomson, of Glasgow, was tried at the measured mile on the Clyde, and attained an average speed of 14¾ knots per hour. The *Trojan* will leave Southampton on her first voyage with the Cape of Good Hope mails of 20th May.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

BREAK-DOWNS WHILE AT SEA.

To the Editor of the MARINE ENGINEER.

SIR,—As a practical sea-going engineer, who is often at his wit's-end to know what is best to be done in the cases of sudden break-downs, I would suggest that your correspondence columns might be turned to very good account by communications from all or any of us referring to cases. For instance, by the communication to one another of the cases of break-downs we might frequently be thereby warned in time to escape the same happening to ourselves. Or, again, by an interchange of ideas amongst us as to the best means adopted for sudden repairs, and shifts used to get to port with, we should frequently be all ready for an accident before it occurred, and thus know at once what to do for the best, and how to do it. This would, no doubt, in many cases, enable even the inexperienced amongst us to so promptly remedy a disaster that we might escape the very serious consequences that so frequently follow a breakdown in the engine-room. Hoping that you will find room in your valuable journal for this suggestion,

I am, Sir, yours very truly,

"AN INEXPERIENCED THIRD."

[We think this suggestion a most useful one; and we shall only be too happy to start a column of "Engineers' Yarns" if our many readers will kindly forward us in any shape, however rough, such of their experiences at sea as may be of value to other members of the marine engineering profession.—ED. *M. Engr.*]

Reviews.

The Shipowners and Engineers' Guide to the Marine Engine. Thomas Reed & Co., Sunderland.

This work, which treats of the history and management of marine engines, presents a very enticing appearance from its handiness and the good execution of the engravings. The matter, while embracing much that will be useful to the sea-going engineer, should prove, we think, of great service to steam ship owners, pointing out to them in what manner to question their engineers, and enabling them to judge whether they are obtaining the largest amount of power with a proper regard to economy. The formulæ for horse-power are simple, and should prove of especial service to owners in this respect. The section treating of the more common forms of "break-downs," with temporary remedies for them, is one which may afford many valuable hints to marine engineers, as it is practical and covers a large number of contingencies.

The portion which gives a concise history of the marine engine is interesting, and well worth perusal. This section concludes with the apposite query, "Has the perihelion of marine engine progress been reached by us? Shall we yet discover in the infinite expanse of science a new motor? Shall electricity furnish the world with an easily manipulated power before which steam shall vanish? Is it at all possible that we may generate by chemical admixture a gas which shall drive engines, or, by acting directly on the water or atmosphere, propel a vessel without the aid of machinery save the gas generator? . . . . . Dreams and theories are the seed of facts-to-be. Therefore we hope that . . . . our masters of mechanics and sons of steam shall strenuously strive after new discoveries, and continue to make experiments, with a view to greater improvements."

When we compare the machinery of the *Comet* in 1812 with that of one of our liners in 1880, and remember that is but 70 years ago, we cannot consider the query and the recommendation ill-timed, and heartily reiterate the hope expressed.

Notes and Novelties.

Raising Sunken Vessels.—An operation took place in the Itchen river, at Southampton, which resulted in the raising of the wreck of the steam-ship Tyne, which had sunk nearly opposite the Gasworks. This vessel formerly belonged to the Royal Mail Steam Packet Company, but had been sold out of their fleet, and was in progress of demolition when, a storm arising, she filled with water and sank, her back being partly broken as she was thrown on to the shoal, where she rested when the operations began. The ship being partly uncovered at low water, an 8-inch steel wire hawser was connected to the stem and stern, and passed over a timber-framing in the centre of the ship, and the ends of the hawser being drawn upon and tightened, prevented any fear of the vessel breaking in two when she rose off the bank. The chief difficulty, however, was to empty the vessel of water in the short time that elapsed between extreme low tide and the period when the ship was entirely covered, as, the decks having been removed, there was nothing to fix any machinery to, and anything left on board during high water must be exposed to the action of the sea water and tide, which runs very quickly at the spot, until low water, thus rendering the use of ordinary pumps almost impossible, or at any rate very troublesome. Application was made to the Pulsometer Engineering Company, of London, who agreed to undertake the pumping. Four of their No. 9 pulsometers, capable of throwing several tons of water per minute, were suspended by chain blocks to the wire rope above mentioned, and iron steam-pipes carried to the side of the vessel, where they were connected by flexible hose to the boiler of the tug Sovereign, remained to supply steam for driving the pumps. Everything being in readiness, pumping was commenced between 4 and 5 o'clock on the morning in question, and all the water was discharged overboard in a very short time. On the return of the tide the wreck rose with it, and by the aid of three steamtugs was safely conveyed across the river into the graving dock during last month.

A New German Corvette.—The German Admiralty are now building a corvette at Dantzic, the body of which is to be exclusively of steel. The keel tiers were a day or two ago completed and connected. The frames and steel plates for the ship's bottom are also ready, the material having been supplied by the "Gute Hoffnungs" foundry in Oberhausen in a condition ready for working. The steel plates were bent while cold, rolled under the hydraulic press, and, as a test, exposed to the blow of a heavy ball dropped from a height of fifteen metres. The metal is of the finest quality. Each plate is made larger than requisite, that the surplus portions may be well proved before delivery. Lightness being the chief desideratum, no heavy wood will be used. The stem and stern, each in a single piece, are of wrought iron from the establishment of Messrs. Krupp. The dimensions are restricted to a length of 71 metres, a breadth of 12·50 metres; the displacement in the front 5·33 metres, behind 6·70 metres, and in the middle 6·01 metres. These figures may be thought to promise no great speed, particularly considering the relation of the length to breadth. A glance, however, at the lines of the submerged portion as shown on the model justify the expectation of unusual mobility. There will be a double bottom, and the vessel will be divided into nine watertight compartments. She will be mounted with ten guns, namely, six on board, two in the bow, and two in the stern. The rigging will be that of a full ship, the lower masts of iron, the top-masts of Hungarian pine wood. The anchors are to be supplied by Mr. Krupp; anchor chains and the other large iron fittings by the "Gute Hoffnung" Company. Should the new corvette answer expectations it may be anticipated that future ships will be constructed of the same material, iron-plating being abolished.

Sadler's Double Rudder and Moveable Propeller Steamship.—The following is a brief description of the invention:—"The rudders are hinged on the rudder-posts in the usual way, with gudgeons and pintles. Both rudders are in use at the same time, which gives double steering power to the ship. The lower after dead-wood is taken away, which enables the vessel to steer much more readily—going both ahead and astern—and at the same time admits solid water to the rudders and propeller. This also allows the propeller to be removed from the dead-wood and stern—a point which the late Mr. Froude strongly recommended, but which it is impossible to adopt in the present construction of steamers. The after end of the keel is 3, 4, or 5 feet wide, according to the size of the ship, narrowed in to its usual width at about 50 feet forward. The propeller is raised and lowered by two vertical *screws resting on the* keel, which can be worked by hand or steam. The after carrying bearing block slides up and down the stern-posts in guides, or can be clamped round the stern-posts. The journal bearing block oscillates in this carrying bearing block. The after bulkhead is behind the universal joint on the shaft, with sliding door (water-tight), and upon the shaft is an oscillating ball, moving in a socket attached to the door. The universal joint is completely boxed in and kept dry. . . The reason why high-powered ocean steamers have such deep draught is to obtain immersion of the propeller; the proportions of vessels fitted with my patent lowering propeller are not governed by this consideration. They can, therefore, be made to draw less water. The draught of water being reduced to obtain an equal displacement, the beam would therefore be greater; but I should recommend even a greater proportionate increase of beam. Vessels built on this principle will also possess greater strength and be safer and better sea boats, because of the superior proportions of construction which the improvements referred to admit of. There will also be no sacrifice of speed, no vibration of the ship, and there will be the greatest possible immunity from accidents to the engines, which are frequently caused by their racing. Again, there will be no thwart-ship bunkers; the extra beam allowing sufficient room for all the coals in side bunkers alongside the engine and boilers. The thwart-ship bunkers when empty are well known to be the principal cause of the straining of the vessel. This straining is caused by the irregularity of load which is unevenly distributed when the bunkers are empty. Its defect would not only be avoided, but the placing of the coals in the side bunkers opposite the engines and boilers would be a great protection to the machinery and boilers of torpedo boats whilst in action, and would enable the ordinary merchant steamer to comply with the Admiralty regulations. Steamers too, could be constructed on this principle so as to admit of being shifted in port without ballast, and even of crossing the seas with little or no cargo excepting coals for the voyage out and home. In case of any accident occurring to the machinery at sea, rendering steam as a motive power impracticable, the propeller can be raised out of the water, and steamers constructed with my improvements could then proceed very advantageously under sail; or, in the case of a steamer going long voyages, such as to Australia, when she got a fair wind the propeller could be raised, and the vessel would go nearly as fast under sail as with steam, and save in each trip from £400 to £500 in fuel alone. This arrangement would be of great advantage to steam yachts. In addition to these and other advantages accruing to the Merchant Service from the improvements I venture to bring forward, steamers will be vastly superior as passenger ships, inasmuch as the vibration, rolling, listing, and other discomforts which are now experienced in Transatlantic and similar voyages will be reduced to a minimum, and the greatest possible comfort secured."

An accident, happily unattended with loss of life, occurred on board No. 3 first-class *Thorneycroft* torpedo boat at Portsmouth on April 5th. It appears that an experiment was being tried with a view of determining the evaporative capacity of the boiler, for purposes connected with the *Polyphemus*, a torpedo boat on a large scale, which is fitted with locomotive boilers. No. 3 was accordingly taken into the harbour just outside the north wall, where the experiment was conducted by engineers Triggs and Chance. An iron tank, capable of holding 200 gallons of water, was fitted on the deck and connected with the feed apparatus below, the water being of the ascertained temperature of 56 deg. F. The furnace and boiler were in charge of a couple of stokers and a fitter, and when the requisite degree of heat had been obtained the boiler was fed from the tank, the steam being allowed to blow off at the escape valve at a uniform pressure of 115lb., or about 15lb. per square inch below the *maximum* working pressure. It was found that the 200 gallon tank was emptied in a quarter of an hour, and with an expenditure of 340lbs. of coal. While the process was going forward the men on board were alarmed by the roaring of steam up the funnel, which showed that something connected with the boiler had given way. Without a moment's loss of time the men were got out of the stokehole, the fans kept going, and the extinguisher, which is made to throw jets of water from the outside upon the fire by means of a steam vacuum, put into operation. The fire was promptly extinguished, and as soon as the smoke, caused by the back draught, had been cleared away, it was found that one of the boiler tubes had burst. This will take about a month to repair, but otherwise no further damage was done. The result of the accident has been to increase the confidence of the officers and men in charge of these boats, since it has proved that the extinguisher is fully able to perform its work, and that there can be no danger from scalding so long as the fan, which drives the escaped steam up the funnel, can be kept in action.

The Gatling Gun.—That useful weapon in certain circumtances of modern warfare, the Gatling gun, has of late undergone several modifications in detail at the hands of its inventor, Dr. Gatling, who has recently had it on view at the offices of Sir William Armstrong & Co., in Great George-street, Westminster. In the old pattern gun the cartridges were supplied from a large drum which was placed end upwards over the gun, the cartridges being delivered somewhat to the side of the weapon, and, therefore, out of line with its axis. The firing handle was placed at the other side, and the barrels and working parts were more or less exposed. All this has now been altered, and the modified gun presents several new features. In the ten-barrelled weapon which has been on view, the barrels and the working parts are enclosed in a gun-metal casing, 2 inches in length and 6½ inches mean outside diameter. Each barrel is 18 inches in length, the outside appearance of the gun being that of a howitzer. The crank handle is now placed at the rear, instead of at the side, and by a re-arrangement of the firing mechanism the speed of the revolution of the gun and the rapidity of its fire has been greatly increased, so that it is claimed for it that it fires 1,000 rounds per minate, the ordinary rate of rapid firing being 750 rounds per minute. That it is well able to fire the larger number appears probable from the rapidity with which it was manipulated with dummy cartridges on the occasion of the inspection. The feeding is now effected from magazines or long cases, each capable of containing 40 cartridges. The case is placed vertically over the centre of the lock chamber of the gun, and the cartridges fall directly into the receivers. As soon as one case is emptied another takes its place, there being two attendants required, one for this work and another to turn the handle. The barrels and locks revolve together, but in addition to this action the locks have a forward and backward motion. This is effected by means of a cam-path, up which each lock travels and pushes the cartridge home. It then fires it, and returns down this path, ejecting the cartridge case from the side of the gun as it returns. The gun can be fired only when the barrels are in motion from left to right; and so long as the crank handle is revolved and the gun fed with cartridges the several operations of loading, firing, and extracting are carried on automatically, uniformly and continuously. Should the crank handle be turned in a reverse direction no harm results to the gun, as the exterior form of the receivers admits of reversing the motion without danger of jamming the cases. The traversing arrangement has also been simplified, and lateral play can be given to the storm of bullets that can be delivered uniformly with the firing of the piece. It will thus be seen that the gun has been greatly modified and improved, and reports from America show it to be capable of some very remarkable performances both as regards rapidity and accuracy of fire. Dr. Gatling has made one of these guns for our own Government which will fire the Boxer cartridge, although he greatly prefers the more solidly made cartridges of the American pattern.

A New Lifeboat.—The formal handing over of a new lifeboat costing £700, presented by the Officers and Cadets in training on her Majesty's ship Worcester, one of the training ships lying at Greenhithe, was effected on April 20th in the presence of a number of ladies and Officers of the Navy, the Committee of the National Lifeboat Institution being represented by Admiral Ward and Captain St. Croix. A prayer for the success of the boat in her work of mercy, offered by the Rev. Mr. Gilmore, opened the proceedings, when Mr. Chambers, the chairman of the Worcester Committee, called upon Captain Smith, the Captain Superintendent, to present the boat. Captain Smith's speech was frequently interrupted by bursts of cheering from the boys. The first large donor, he said, was Jack Robinson, a well-known former cadet, whose uncle had left a legacy of £3,000 to the National Lifeboat Institution. Though he was bound to acknowledge the munificent subscription of Captain R. L. Ward, amounting to £53, the fund of £700 was largely made up of smaller subscriptions from the boys and their friends, and he was glad to say that that was not the only subscription to which they had largely contributed, the *Captain* Fund and many local objects having obtained solid proofs of their sympathy. Admiral Ward, in accepting the gift, explained how the boat came to cost so large a sum as £700. The boat alone cost £290, being formed of mahogany, with diagonal planking extending from gunwale to gunwale, and furnished with air-tight and water-tight cases, and various other appliances, so that if it got on a rock and had a big hole knocked into it, it would still ride out a storm and save life. Mr. Chambers and Captain St. Croix having also spoken, the ceremony concluded by the breaking of the usual bottle of wine over the bows of the boat, which was performed, amid the cheering of the boys, by Mrs. Smith, the wife of the Captain Superintendent. The boat is named *The Worcester Cadets.*

The Load-line.—The official report into the circumstances attending the supposed loss of the British steamship, *Kensington*, of London, while on a voyage from Liverpool to Havannah, states that the load-line was not placed in a proper position on the ship's side; that when the ship left on her last voyage she was overladen; that the load-line was placed where it was by the order of the owners' agents, and with the knowledge and sanction of the owners; that she was overladen with the knowledge and sanction of the owners or their agents; that in the opinion of the Court the loss, or supposed loss, of the vessel is probably due either to her having been swamped or overturned, owing to insufficient stability, or to an explosion of coal gas on board. The official report into the circumstances attending the supposed loss of the steamship *Marlborough*, of Hull, while on a voyage from Cardiff to Genoa, with a cargo of coals, states that the load-line was not in a proper position on the ship's side, either at 4 ft., or even at 4 ft. 6 in. below the upper deck; that when the ship left on her last voyage she was overladen; that, apart from all questions of overloading and of ventilation, the cargo was properly stowed and trimmed; that she was not properly or sufficiently manned; that looking to the form and dimensions of the vessel, the depth to which she was loaded, and the nature of the cargo which she had on board, she had not sufficient stability for a winter or for any voyage; that her loss was probably due to her being swamped or overturned; that the load-line was placed at 4 ft. below the upper deck by the order and with the knowledge and sanction of the managing owner; that she was overladen and undermanned with the knowledge and sanction of the managing owner. The Court accordingly condemned David Parkinson Garbutt, of Marlborough-house, Anlaby-road, Kingston-upon-Hull, in the sum of £250, £50 thereof to be applied towards the expenses of the Court, and £200 towards the expenses of the Board of Trade.

The whole of the armour having been affixed to the fore turret of the *Inflexible*, the turning machinery was tried for the first time on April 8th, at Portsmouth, under the superintendence of Mr Durston, of the Factory Department, Mr. Littlejohn, Assistant to Chief Engineer at Sheerness, and Mr. Hefferman, the chief engineer of the ship. The turret having been advanced almost to completion, the turret leathers, which span the space between the ship proper and the armoured wall, are about to be taken in hand. As these leathers slide over the glacis plates, it is necessary that the latter should be reduced to a smooth surface, so that a proper adjustment may be attained and the entrance of water prevented. In order to accomplish this it is intended to make the turret as it rotates perform the duty of a planing machine, and thereby polish its own glacis plate. The turrets of the *Inflexible* have an internal diameter of 28 ft. and an external diameter of 33 ft. 10 in.; and though the two 80-ton guns with which each will be armed are not yet placed on board, it was estimated that the mass which was moved for the first time weighed about 320 tons. The power by which the turrets of the *Inflexible* are turned is hydraulic, and thus differs from both the *Thunderer* and the *Dreadnought*, the turrets of which are rotated by steam, which is not so certain nor obedient. In the larger ship the same silent, docile, and rigid force which loads, elevates, and depresses the gun is also called into requisition to rotate the turrets, the special advantage being that it can be stopped dead without locking gear, and can be made to perform its work so creepingly and uniformly that the movement of the gun in the turret may be said to resemble the movement of the minute pointer of a watch. The hydraulic power is furnished to each turret by a pumping engine working up to 170 horses, and of the same type as those supplied by the Elswick firm to the *Duilio* and the *Dandolo*, and to the Chinese gunboat flotilla. The power thus generated is applied to turn the turret by two hydraulic engines, one being used as a reserve in case of an accident happening to the other. The motive power is transferred to a crank shaft by three oscillating rams, the plungers of which are 4½ in. in diameter, and have a stroke of 1 ft. 6 in. This crank actuates a pinion which runs in a rack around the base of the turret, and turns the mass. At the trial yesterday the turret was rotated by the port engine in one minute eight seconds with 42 revolutions of the engine, and was then reversed in one minute ten seconds with 40 revolutions. The port engine was then disconnected, and with the starboard hydraulic engine in action the turret was turned in 1 min. 16 sec. with 37 revolutions, and reversed in 1 min. 18 sec. with 36 revolutions. The pressure on the plungers was 750 lb. on the square inch, and the pressure of steam at the pumping engine 68 lb. The turret was subsequently rotated at a creeping pace, and was thoroughly under the command of the engineers.

BOARD OF TRADE EXAMINATION.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Dawes, Joseph ...	2 C	London.
Reid, Jas. M. ...	2 C	do.
Rance, Thos. T.	2 C	do.
Abbott, Wm. S.	1 C	do.
Daniels, A. T. G.	1 C	do.
Bambra, Geo. ...	2 C	NShields
Scott, Alex. W.	2 C	do.
Oldroyd, Ben. L.	2 C	do.
Robson, John ...	1 C	do.
Utley, Thomas ...	2 C	London.
Stewart, Chas. ...	1 C	do.
Smith, George ...	1 C	do.
Davidson, D. ...	1 C	Abrdn.
Waters, R. R. ...	2 C	Plym'th.
Croudace, Thos....	2 C	NShlds.
Forte, Fred ...	2 C	do.
Cole, John W. ...	2 C	do.
Burlinson, W. A.	2 C	do.
Maddison, John...	2 C	do.
Robinson, Wm....	1 C	do.
Hamilton, John...	2 C	Glasgow.
Baker, Wm. H. ...	2 C	do.
Brownlie, John ...	2 C	do.
Douglas, Hugh ...	2 C	do.
Marshall, H. C. ...	2 C	do.
Love, William ...	2 C	London.
Kelly, Edward ...	1 C	do.
Grimstead, G. H.	2 C	Sndrlnd.
Banks, Joseph ...	1 C	do.
Hara, W. J. ...	1 C	do.
Watson, Wm. ...	2 C	Leith.
Philp, Robert ...	1 C	do.
Neill, Wm. R. ...	2 C	N Shlds.
Dean, Isaac ...	1 C	do.
Fraser, Duncan ...	2 C	London.
M'Pherson, J. D.	2 C	do.
Gardner, Peter ...	1 C	do.
Kendrick, Edwd.	1 C	do.
Meikle, James ...	2 C	Grnock.
Chiene, W. G. ...	2 C	do.
M'Coll, Archd. ...	2 C	do.
Johnson, Robt. ...	2 C	N Shlds.
Blackett, Thos. N.	1 C	do.
Barclay, John ...	2 C	Lvrpool.
Morgan, James ...	2 C	do.
Taylor John ...	2 C	do.
Fraser, Alex. G....	2 C	do.
Sword, William...	1 C	do.
Pierce, Saml. D...	1 C	do.
Anderson, Peter	2 C	Glasgow.
Lees, Wm. C. ...	2 C	do.
M'Ilwraith, John	2 C	do.
Binnie, John ...	2 C	do.
Crichton, Alex. G.	2 C	do.
Stewart, Gilbert...	1 C	do.
Johnston, Wm. ...	1 C	do.
Fleming, John ...	1 C	do.
Crawford, A. D...	1 C	do.
M'Alpine, T. L...	1 C	do.
Turpie, James ...	1 C	do.
Voce, Joseph ...	2 C	Lvrpool.
Hatrick, James ...	1 C	do.
Ross, Harry ...	1 C	do.
Chalmers, Jno. C.	1 C	do.
Maker, Joseph ...	1 C	do.
Porteus, John ...	2 C	N Shlds.
Cook, Fredk. ...	2 C	do.
Mason, John ...	1 C	do.
Bain, John ...	1 C	do.
Owen, John W....	2 C	Lvrpool.
Kerr, Robert ...	1 C	do.
Blackburn, Geo...	1 C	do.
Johnson, John ...	1 C	do.
Formby, M. G. ...	1 C	do.
Henderson, A. ...	1 C	do.
Parsonage, Thos.	2 C	do.
Prahm, A. C. C.	1 C	P'moth.
Snook, Wm. ...	2 C	Bristol.
Jones, Henry ...	2 C	do.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

THE JAPANESE NAVY.—In the *Japan Directory* for the current year, published at Yokohama, a list of the 24 vessels at present comprising the strength of the Japanese Navy is given. It is as follows:—"*Adzuma-Kan*, ironclad-screw, 700 tons, 3 guns, 500-horse power; *Amaki-Kan*, fourth-rate, screw, 908 tons, 9 guns; *Asama-Kan*, third-rate, screw, 1,104 tons, 12 guns, 300-horse power; *Chiyoda-gata-Kan*, sixth-rate, 100 tons, 3 guns, 60-horse power; *Fujiyama-Kan*, third rate, 1,000 tons, 13 guns, training sailing ship; *Fuso-Kan*, twin screw, armour-plated, second rate, 3,740 tons, 3,500-horse power, 12 guns; *Hiyei-Kan*, screw, third rate, composite corvette, 2,200 tons, 2,500-horse power, 13 guns; *Hosho-Kan*, fifth rate screw, 173 tons, four guns, 60-horse power; *Iwaki-Kan*, screw, 600 tons, 650-horse power, 3 guns (now building at Yokoska); *Jinjel-Kan*, P. W. Imperial yacht; *Kaimon-Kan*, 1,490 tons, 1,250-horse power, compound engine, eight guns (now building at Yokoska); *Kasuga-Kan*, flagship, fourth rate, paddle-wheel, 7 guns, 300-horse power; *Keuko-Kan*, fourth rate, screw training ship, 300 tons; *Kongo-Kan*, screw, third rate, composite corvette, 2,200 tons, 1,500-horse power, 13 guns; *Moshiun-Kan*, fifth rate, 305 tons, 4 guns, 100-horse power; *Nisshin-Kan*, fourth rate, screw, 784 tons, 18 guns, 250-horse power; *Kaidem-Kan*, old, 240 tons, 80-horse power, 4 guns; *Riojo-Kan*, third rate, iron belt, screw, 1,459 tons, 14 guns, 280-horse power; *Set'tsu-Kan*, fourth rate, store ship: *Sei-Ki-Kan*, fourth rate, screw, 898 tons, 8 guns, 180-horse power; *Sooriu-Kan*, yacht; *Teibo-Kan*, fifth rate, screw, 125 tons, 5 guns, 60-horse power; *Tenrio-Kan*, screw, 1,490 tons, 1,250-horse power, compound engine, 7 guns (building at Yokoska); *Tsukuba-Kan*, *third rate, screw,* training ship, 1,033 tons, 12 guns, 200-horse power."

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 19th March to 8th April, 1880.

Prepared especially for THE MARINE ENGINEER *by Fell and Wilding, City Patent Office,* 23, *Rood Lane, Fenchurch St., London, E.C.*

1194 J. Walker. Rotary motive power engines.
1198 H. H. Lake (communicated by W. N. Fairbairn, H. T. M'Learn, and W. H. Ingersoll). Governors for marine engines.
1204 C. Ménard. Rotary engine.
1213 J. Sample. Buoys, or life and property saving apparatus for sea-use.
1214 S. W. Wilkinson, F. Preston and J. B. Hamond. Steam engines.
1218 L. K. Scott. Sighting ordnance and apparatus employed therein.
1222 W. Prowett. Steam engines.
1228 S. Willoughby. Water distilling apparatus.
1263 R. Langensiepen. Supplying feed-water to boilers.
1290 C. Mace and J. Brewster. Fire-bars.
1302 B. J. B. Mills (communicated by J. H. M'Lean and M. Coloney). Forts, fortifications, armour-plating, &c.
1308 A. M. Clarke (communicated by A. L. Harrison). Lubricating steam engine cylinders and valves.
1320 W. Potter. Metallic pistons and means of adjusting packing rings.
1323 A. Graf. Portable buoyant apparatus for saving life from drowning.
1326 J. B. Ward. Propellers.
1334 J. C. Etchells. Steam cocks and valves.
1346 W. R. Lake (J. L. Lay). Torpedo boats, and propelling and controlling same.
1373 J. E. Liardet. Spring and double-acting windlass.
1374 J. E. Liardet. Automatic mushroom anchor.
1375 J. E. Liardet. Double-grip anchor.
1384 C. Kesseler (communicated by M. Gehre). Steam engines.
1408 J. A. Novello. Construction of ships or vessels.
1413 W. Gamer. Apparatus for fuel feeding and actuating moveable fire bars.
1431 T. Turton. Crank shafts and crank axles.
1437 J. McNeil. Introducing, heating, and extracting air from feed water of boilers.
1466 A. Graf. Diving and swimming apparatus.
1475 F. Wirth (communicated by M. M. Manly, R. Patterson, and W. J. Philips). Telegraphic cables.
1484 A. S. Haslam. Refrigerators, or surface condensers, applicable to air cooling or freezing machines for preserving meat, &c.
1488 K. W. Jurisch and J. H. Lewis. Steam engines.
1501 E. B. Campbell. Method of unloading vessels, and apparatus therefor.
1530 P. Jenson (communicated by J. Nilsen). Rotary steam engines.
1542 S. Ward. Compositions for coating ships' bottoms, &c.
1559 J. W. de Caux. Apparatus employed in catching crabs, lobsters, &c.
1562 F. A. Capps. Oyster dredges.
1564 G. Davies (communicated to him by A. Cords and A. Deininger). Prevention or removal of incrustation in steam boilers.
1573 J. B. D. Boulton. Facilitating repairs, &c. upon screw propellers whilst the vessel is afloat.
1589 J. Robb, jun. Working valves.
1593 C. Nichols. Stopping rush of water into a ship when the exterior skin becomes fractured.
1601 H. J. Haddan (communicated by M. Beasly). Life saving rafts.

⁂ Any information regarding the progress, &c., of these patents will be gladly furnished on application.

THE new armour-plated torpedo ram *Polyphemus*, four guns, under construction at Chatham dockyard, is making most satisfactory progress, a large force of men being employed upon her. It is hoped that she will be launched in a few months, as the Admiralty are desirous of having her completed at as early a date as possible. Some of her internal fitments will shortly be commenced, but they will not be open to the inspection of foreigners.

ROBERT WALKER'S PATENT HYDRO-CARBON FURNACE AND APPARATUS

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals, &c.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel, burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; the equivalent in Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in the case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no sparks or burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c., and economy in voyage.
8.—Cleanliness, and easier and quicker voyages.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, &c., without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

THE INVENTORS' RECORD.—"Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S., (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with the coal."

THE RAILWAY RECORD states, "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers."

The MARINE-ENGINEER.—"For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage."

INDUSTRY.—"At a trifling cost an enormous degree of heat was easily attained, estimated at 5000 degrees by which iron was easily melted in ten minutes, instead of taking in ordinary circumstances two hours, and glass in two hours instead of sixteen."

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"These advantages are immense, and must eventually effect a complete revolution in our present mode of steam generation."

For prices, &c., and for terms for working this patent under royalties or licences or otherwise, apply to the patentee, Mr. R. Walker, 19, Buckingham-street, Strand, W.C.

NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

The Marine Engineer,

LONDON, JUNE 1, 1880.

EDITORIAL NOTES.

THE late loss of the *American*, has brought home most forcibly to us two most important necessities for sea-going liners. One of these necessities we have lately been strenuously advocating, viz., the adaptation of large independent donkey-engine power to all liners, in the shape of centrifugal pumps, pulsometers, or ram pumps. The great improvement we advocate is, that such pumps must necessarily be complete in themselves, with independent steam cylinder, so that any breakdown of the engine should not prevent the working of the pumps. We have also pointed out that in order to give the greatest possible size to the pumps with economy, these donkey pumps may be advantageously employed in ordinary circumstances in circulating the water through the surface condenser, as well as for general bilge and deck purposes. Had the *American* been fitted with large pumps of this class, capable, with a good supply of steam, such as there was available, to run at almost any speed, she need never have foundered at all. The total inability of the hand and donkey engines to cope with the stream of water entering the leak, obliged the early abandonment of the vessel. Had the pumps been masters of the leak, there is no doubt that some ingenious method of stopping the leak would have been discovered, either by tow, sail-cloth, or other means.

THE next important lesson to be taken from this disaster, and from those whose termination is frequently much more disastrous than that of the *American*, is the necessity for better, quicker, and more powerful boats to be carried by all large passenger vessels. This improvement we consider can be best effected by the application of steam power to one or more launches to be carried by such vessels. We gave particulars in our April number, of a new unsinkable life-boat, patented by Mr. J. Long, to which he has applied steam power. There is no doubt that this will be a great boon to the lifeboat crews who, have such fearfully exhausting toil. We think, however, that this idea might be advantageously employed for adaptation to boats carried by steamers at sea. As it has been remarked by many correspondents, the possession of a steam launch would frequently have enabled stranded or disabled vessels to send for relief, or such a launch could be used to tow a raft or a string of boats, so as to keep the survivors of a crew together, and to enable them to make such way as readily to reach a port.

WE draw attention to a letter in our correspondence columns from Charles George Brooke-Hunt, late of the Royal Navy, who is engaged in a very creditable effort to raise the requisite funds for a public memorial to the officers and crew of Her Majesty's ship *Orpheus*. The foundering of this vessel was one of the most gallant incidents amongst the many that adorn the annals of our navy. This unfortunate ship, it may be remembered, went to pieces in 1863, on the Manukan Bar, off Auckland, New Zealand. Owing to the negligence of the man at the signal station, the *Orpheus* went aground on the bar, some miles from land. The sea and surf were so heavy that it was impossible to launch the boats, and the ship was bound to knock to pieces in a few hours. The conduct of all on board seems to have been most heroic. Discipline was maintained throughout the ship, the crew remaining at quarters or obeying orders cheerfully and promptly, though many were washed overboard in doing so. No one mounted the rigging till ordered to do so; and as the masts were successively washed overboard, the poor fellows gave three cheers as they went down to their watery grave. We sincerely hope that Lieutenant Brooke-Hunt's efforts will be rewarded with success in raising suitable funds to commemorate so gallant an epitome in the history of our navy.

A STARTLING result has been obtained on the Pensylvania Railroad, by testing 5,000 employés for colour blindness. An extraordinarily large proportion were unable to distinguish green from red. One young man either guessed or made a lucky designation as to the test colour submitted to him being red, but being requested to select similar shades from a large assortment, picked three shades of blue, two of yellow, and one of red, and could not distinguish any difference between them. The same thing happened to half-a-dozen others who followed him. It is evident that colour blindness is much more widely spread than is generally thought. It has struck us that this may have frequently been the explanation of many cases of collisions at sea at night, in which *the evidence is* extremely contradictory as to which light was first sighted, whether starboard or port. It is very possible that a large proportion of seamen and mates may suffer from this affliction of colour blindness, and this would then account for the extraordinary courses held sometimes by colliding vessels on the high seas or on the river. We would recommend all careful captains to test, not only their mates, but all and each of the able seamen who might have to take a spell at the wheel, for colour blindness.

A NEW project for raising sunken bodies comes before us from Hanover. Mr. Raydt, of that town, proposes to use balloons under water, to be inflated by carbonic acid gas, so as to raise the sunken vessel or object by suitable chain attachments. It is proposed to make the balloon of strong canvas, lined with caoutchouc, and saturated with a solution of caoutchouc. Above and below it would be strengthened with metallic plates, connected by netting, to take the principal strain. The carbonic acid gas is stored in the baloon in a highly compressed condition, so that the balloon may be readily taken down in a collapsed condition. The communication between the reservoir and balloon is first partly opened, so as to cause it to sustain its own weight. The balloon is then to be fastened to chains passed round the vessel, and the valve to be fully opened, so that by the expansion of the balloon a great displacement may be caused, sufficient to float a very considerable weight. Automatic escape valves are fitted to the balloon, so that any undue pressure may escape as the balloon rises. This reads very feasibly, and we think there is no doubt that sooner or later sunken vessels and objects will be raised when the water is moderately shallow. We do not apprehend that the difficulty even now exists in the means of obtaining buoyancy, but rather in the means of attaching any buoyant body to a sunken vessel. It is all very well to talk of attaching these buoyant balloons to chains passed round a vessel. The difficulty is still unexplained as to how to get the chains under the vessel, particularly if she is at all silted up.

OUR sailors on board the new ironclads are very much afflicted with rheumatism. This is a very serious drawback when, in addition, it is remembered that there is very little ventilation and no daylight in those huge iron coffins, sunk for the most part below the level of the sea. May not this rheumatism be caused by the deposition of water which results from the combustion of the enormous number of candles burnt on board ship. It would be an interesting calculation to estimate what weight of water per day is deposited on the interior walls of our ironclads from so much weight of candles consumed. The amount of water would be startling to many people, and we believe fully account for the dampness and unhealthiness of these iron coffins. Should this be the case, it is incumbent on our Admiralty to adopt another method of lighting, such as that by electricity, which would not deposit water by combustion.

AT what rate does the wind flow? Perhaps some of our seafaring readers can give us some idea. It would certainly be conferring a boon on practical science if some sea-going engineer could conveniently make and fix an anemometer at the mast-head, so as to give some reliable data as to the real speed at which the wind blows. The late discussion as to the possible effect of the wind pressure upon the Tay Bridge has but served to show how little we know about it. The Astronomer Royal seems to think that 10 lbs. a square foot is as much as is ever developed as an average in England. If, however, we think of the violent effects produced by wind pressure upon the sails of even bare masts, and shrouds of vessels when exposed to violent gales or hurricanes, we cannot but think that this estimate is very much below the fact. We should like to see a practical estimate of the total pressure required to throw a vessel on her beam ends, and what this would come to per square foot over the surface of resistance offered to the wind. The reports also of Mr. Glaisher, as to the effect of wind current on his balloon, are very contradictory, compared with registered speeds at the Royal Observatory. He records one instance of a journey performed in the balloon at the rate of 30 miles an hour when the Observatory only registered a wind speed of 2 miles an hour. In anothe case the balloon speed was 35 miles an hour whilst the registered wind speed was only six. Cannot some of our sea-going readers contribute some information or observations on this point?

A VERY interesting summary has just been published of the statistical returns of the navigation and shipping of the United Kingdom. The first interesting point is that even in these hard times there is an increase in tonnage of shipping entered at ports of the United Kingdom of 3 per cent., and an increase in clearances of 2 per cent., in 1879 as compared with 1878. This increase is entirely in British vessels, the foreign vessels showing a decline of 6 per cent. in entries and 7 per cent. in clearances. Thus the carrying trade of Great Britain and the proportion of that of Great Britain to foreign countries is greater now than ever it was. The increase of carrying capacity, as represented by time, is much greater than what is indicated by the preceding figures, owing to the great relative increase of steam tonnage compared with sailing tonnage. If a steam ton be allowed to be equal in effectiveness to 4 sailing tons, the comparison between the mercantile carrying capacity of the United Kingdom in 1870 and 1880 is nearly as 1 to 2, or our effective capacity is nearly doubled. In 1870 the steam tonnage was only about 1,000,000 tons steam, which may be considered as equal to 4,000,000 tons sailing and the actual tons sailing were also about 4.500,000, making a total of 8,500,000. Now our total tonnage amounts to about 8,500,000 actual, of which 2,733,269 are steam tons, this makes a total effective of about 16,000,000 tons. The total of all the other principal maritime countries amounts to 11,000,000 tons effective, so old England is still well to the fore and is yet outstripping her competitors.

A SHIP RAILWAY.—Captain Eads, the projector and executor of the work of the Mississippi jetties, read a paper before the Congressional Committee at Washington a short time since in advocacy of his plan of a ship railway. He claimed that a substantial and durable ship railway can be built for half the cost of a canal with locks, and of one-fourth that of a canal at tide-level; that such a ship railway can be built in one-third or one-fourth of the time needed for the construction of a canal; that, when built, ships of the maximum tonnage can be moved with safety at four or five times greater speed than in a canal; that a greater number of vessels per day can be transported by the railway than can possibly be transported by the canal; that the capacity of a ship-railway can be easily increased to meet the demands of commerce; that the cost of maintenance of the roadway and rolling stock would be much less than that of the canal, and that a railway can be constructed and operated in localities where it is not practicable to construct a canal. He explained his plan by means of drawings, which showed a pit 3,000 feet long, in which the railway should be made into the harbour to a depth of 30 feet, ascending to dry land at a grade of one foot in 100; then showing the cradle into which the ship is to be lifted, and explaining how the ship is to be kept in place in the cradle by means of blocks 6 ft. or 10 ft. apart; then showing the railway, consisting of 12 rails of the ordinary width; the wheels under the cradle to be at 3 ft. distance from each other, and to bear a pressure of five tons (the average pressure on the driving wheels of freight locomotives being 6½ tons while at rest). This five tons of pressure on the driving wheels is to be the maximum pressure. Ordinarily it would not be more than three or four tons, but the wheels could be made to stand a pressure of 30 tons. The possibility of derailment, he said, was reduced by the number of rails and by the great weight of the ship itself, so that it would be impossible to get a ship off the rails. He went on to say that an increase of traffic could be easily provided for by the laying of additional tracks, and that the great number of wheels and rails would so equalize oscillation that at a speed of 12 miles an hour there would be scarcely a sign of motion on a glass of water on a table in the ship's cabin. It was remarked that in the drawing of a ship on the railway the locomotive bore the significant name of *James Monroe.* He was asked by Mr. Conger as to the safety on such a railway of a large vessel of middle age, and whether the ship would not be liable to a strain. His reply was that any vessel that was built and was fit to be passed by Underwriters, and was thought capable of withstanding the gales and hurricanes of the Atlantic or Pacific Oceans, was capable of being carried on this railway with absolute safety. He said that his plan had been received with favour by Mr. E. J. Reed, the Chief Constructor of the British Navy; Mr. John Roach, Mr. Henry Steers, and a great number of the most eminent engineers of America. M. de Lesseps said he had listened to Mr. Eads with respect, because he knew him to be an engineer who had done the most remarkable work of the day, and because the most remarkable engineers generally studied the most difficult things; still the plans of a railway and of a canal were totally different things, and he (M. de Lesseps) did not want to discuss the plan of a railway because it was not his own plan at all. It had never been tried, though it had been proposed. It had even been proposed to him by Marshal Vaillant, when he was War Minister under Napolean III. for the Isthmus of Suez. If a ship railway was practicable, of course it could be built anywhere. Mr. Eads said he was very much obliged to M. de Lesseps for the complimentary manner in which he had spoken of him, although his opinion of him was based on hearsay alone, while his (Mr. Eads's) opinion of M. de Lesseps was based on the fact of his having seen his work.

MARTYN-ROBERTS' PATENT SPRING SAFETY VALVES.

ONE of the most important of the many improvements which have been made in connection with Marine Engines during recent years, has been the substitution of Spring Safety Valves for the old-fashioned valves loaded by direct weights. With safety valves loaded with dead weights, every time the ship rolled or pitched, the valve was eased, and a certain quantity of steam escaped, which was equivalent to a considerable waste of fuel. The Board of Trade were with some difficulty at last persuaded to allow the use of valves loaded with direct springs, but the permission was accompanied by the following stringent conditions:—

1st.—That at least two separate valves were fitted to each boiler.
2nd.—That the valves were of the proper size.
3rd.—That the spring and valve be so cased in that it cannot be tampered with.
4th.—That provision be made to prevent the valve flying off in case of the spring breaking.
5th.—That the requisite safety valve area is cased-in in the usual manner of Government valves.
6th.—That screw lifting gear be provided to ease all the valves, if necessary, when steam is up.
7th.—That the size of the steel of which the spring is made is to be found by the following formulæ:—

$$\sqrt[3]{\frac{S \times D}{c}} = d.$$

S = The load on the spring in lbs.
D = The Diameter of the spring (from centre to centre of wire) in inches.
d = The diameter on side of square in inches.
c = 8,000 for round steel.
c = 11,000 for square steel.

8.—That the springs be protected from the steam, and impurities issuing from the valves.
9.—That when valves are loaded by direct springs that the compressing screw abuts against a metal stop or washer when the load sanctioned by the surveyor is on the valve.

In no case is the surveyor to give a declaration for a spring-loaded valve, unless he has first fully mastered the details of its construction, and unless he has tried it under full steam and full firing for at least 20 minutes with feeds and stop-valves shut off, and if in any case the details of construction do not satisfy him, or if the accumulation of pressure exceeds 10 °/o of the loaded pressure, he should not give his declaration without first reporting the case to the Board of Trade accompanied by a sketch and full particulars of the trial, and of the *strength* pressure of the boilers.

It is unnecessary to say that it is not every valve that will fulfil the above conditions, and therefore the manufacture of marine safety valves has been confined to a few makers who have had more or less the monopoly of this trade. In this number we illustrate the Martyn-Roberts Patent Safety Valve as specially designed for marine boilers, and which is now being manufactured by Messrs. Alexander Wilson & Co., Vauxhall Iron Works, Wandsworth-road, S.W., and which fulfils all the conditions required by the Board of Trade. The principle upon which this safety valve works is easily understood. The upward pressure of the steam acting on the inside of the dome, the valve is removed from the disturbing influences of the steam escaping at the orifice, a steady action and largely increased efficiency are thus obtained. The relieving power is many times that of an ordinary safety-valve, and the boiler is relieved in the shortest possible time, while the valves close with the least possible loss of pressure. The valve has no feather guides and cannot be stuck fast and jammed in its seat. When locked up it is absolutely beyond reach of being tampered with, but when the padlock is removed, the valve can be readily adjusted without breaking the joint. Levers are fitted to each valve to which a rod can be attached, communicating with the stoke-hole, so that the stoker can at any time relieve the valves or see that they are working properly. The Board of Trade rule for these safety valves is half a square inch of area of safety valve for every square foot of fire grate surface of the boiler.

We believe that many of the older steam vessels are still fitted with safety valves loaded by dead weights, but we think that when spring safety valves at the moderate prices charged by Messrs. Wilson & Co. can be obtained, the latter will be universally used.

SPEED CALCULATIONS.

THE calculations required for determining the power necessary to drive a vessel of given displacement and model at a given speed have initiated much scientific discussion, and have led to the promulgation of very many and diverse theories.

As an example of the great differences of opinions that existed a few years back amongst scientific men on this subject it will be remembered that during the construction of the *Great Eastern*, several correspondents of "The Artizan" ventilated their views as to the probable speed she would realize, and which was variously estimated at from 14 to 30 miles per hour. Mr. Atherton, however, came very near the mark, the result of his calculations corresponding very closely with the actual speed obtained.

It is generally accepted that the resistance to a vessel moving through the water varies as the square of the speed, and consequently the power required to overcome that resistance as the cube.

On this assumption the power necessary to drive any given vessel at a certain speed being known, that required for any other speed is readily estimated; but it has been shown by experiments conducted by Mr. W. Denny, that the cube theory is not in all cases so correct as had been generally supposed.

The problem which a constructor is most frequently called upon to solve, is, what speed a vessel of certain proportions and power may be guaranteed to realize; this is of course a very important matter and has to be decided on before the designs are got out in detail, and must also be gone into very accurately, as purchasers generally require first cost and working expenses reduced to a minimum, whilst speed and carrying capacity are to be at the maximum.

Mr. Atherton's formula that have been in use for several years, go on the supposition that for ships of similar form, the resistance at any given speed varies directly as the area of the Immersed Midship Section, and as the cube root of the square of the Displacement.

To handle these rules it is necessary to have two sets of co-efficients to suit the forms of the various vessels that from time to time require to be dealt with, so that on the suitability of the co-efficient used to the vessel in question, depends the correctness of the calculations.

The late Professor Rankine made some very elaborate investigations in this direction, from which he deduced his method of computing speed by the "Augmented Surface," that is, the wetted surface of the vessel by a co-efficient depending on the mean angle of entrance; this, however, although giving results corresponding very nearly with those obtained by experiment, involves too much laborious calculation to be of general use.

There is no doubt that the wetted surface of hull, qualified by the mean angle of entrance, and general form of vessel, is the best basis on which to estimate the resistance.

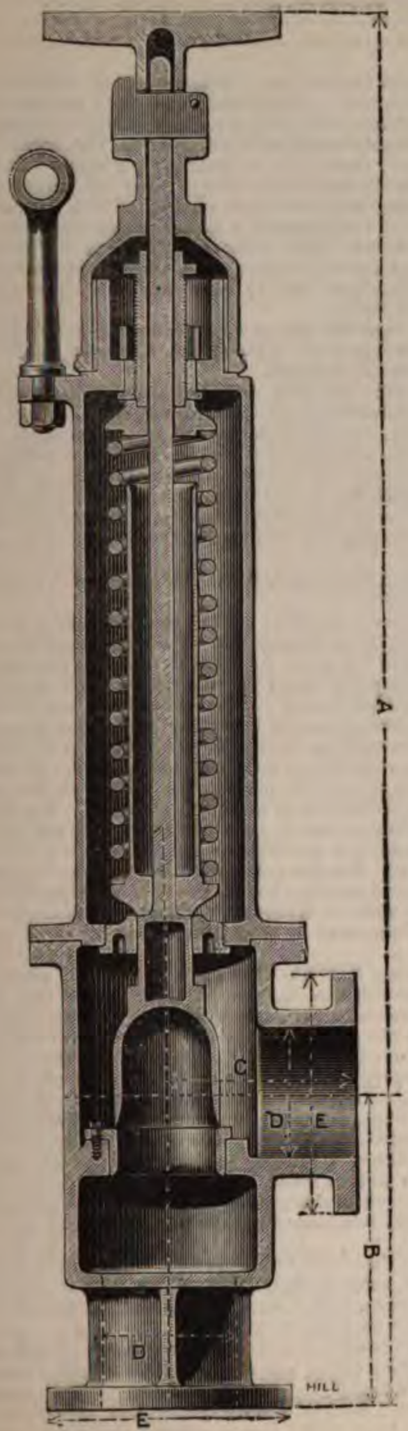
At a recent meeting of the Association of Naval Architects, a paper by Mr. A. C. Kirk on "A Method of Analysing the forms of Ships" was read, and which contains much valuable information on this subject.

Mr. Kirk's analysis consists in setting out a block vessel having a parallel middle body, tapering ends and rectangular cross sections, so proportioned that the Immersed Midship Section is a rectangle of equal area with the J. M. S. of the vessel under consideration; the triangular ends subtending angles equal to the mean of those of entrance and run, whilst the cubic content of the block equals the displacement of the vessel.

It will be seen at once that the surface of such a block can be very quickly run out, and it is found that it bears a very nearly constant proportion to the wetted surface of the actual vessel, and having also the mean angle of entrance. We have thus all the advantages of the "Augmented Surface" obtained by a very simple process.

OLD SUPERSTITIONS.—It used to be a common thing for sailors to refuse to go to sea on a Friday. We hear nothing of this in these steamboat days. Steam has made every day alike. Steam has been a great changer, and in the matter of popular superstitions it has proved the great reformer. Wherever steamboats and steam-engines appear superstitions disappear, ghosts, fairies, witches are speedily forgotten. Who ever heard of a ghost in a railway station, or of a bewitched cattle truck, or of a haunted saloon carriage? The thing is impossible. The most expert seer could not find a ghost in a first-class waiting room—could not even imagine such a thing. Ghosts like very different quarters—old houses, wainscoted rooms secret passages, and scanty visitors.—*Antiquary*.

MARTYN-ROBERTS' PATENT SPRING SAFETY VALVES.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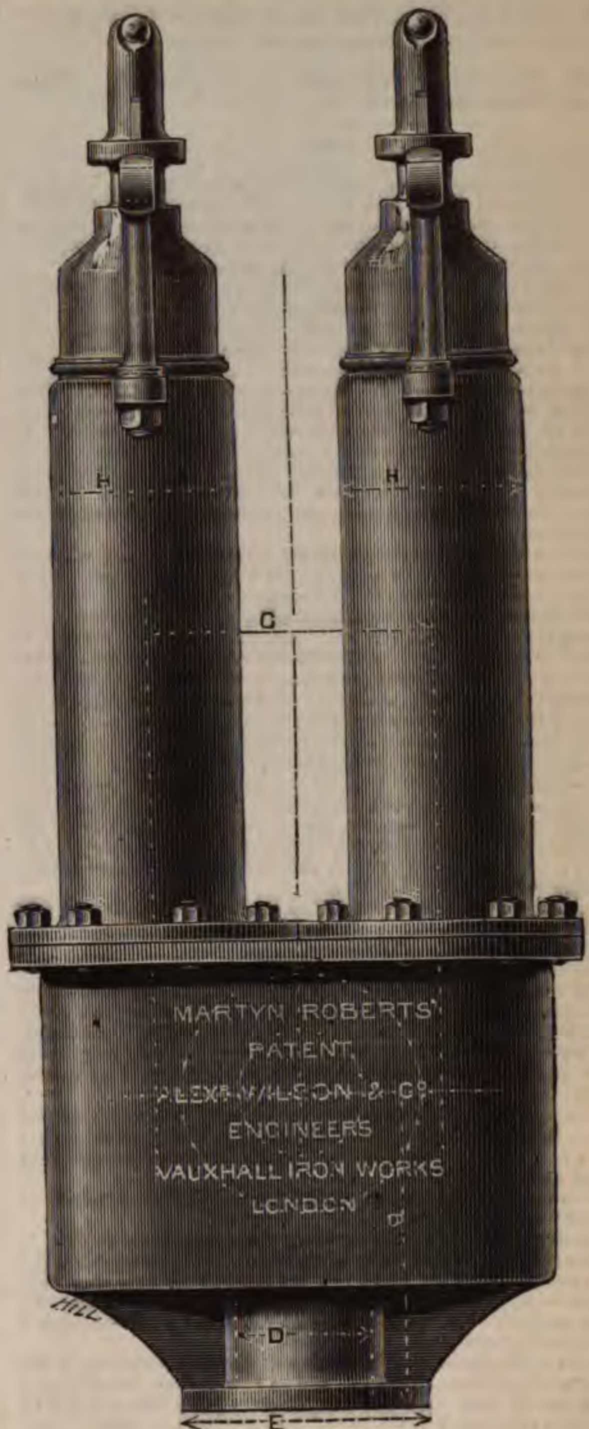
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ON STEEL FOR SHIPBUILDING.

By Henry H. West, Chief Surveyor to the Underwriters' Registry for Iron Vessels, Member.

[Read at the Twenty-first Session of the Institution of Naval Architects, 19th March, 1880.]

In a Paper read before this Institution in 1875, Mr. Barnaby, Chief Naval Architect of the Royal Navy, used these words:—"The question we have to put to the steelmakers is: What are our prospects of obtaining a material which we can use without such delicate manipulation and so much fear and trembling? . . . . We want a perfectly coherent and definitely carburized bloom or ingot, of which the rolls have only to alter the form in order to make plates, with qualities as regular and precise as those of copper and gun-metal, and we look to the manufacturers for it."

It is no part of my present purpose to enquire whether all the "delicate manipulation" was necessary, which Mr. Barnaby described in the Paper from which I have quoted. It is enough that five or six years ago steel was used with "fear and trembling." It is largely due to the influential example of the Admiralty, and to the firmness with which Mr. Barnaby and his staff have insisted on uniformity of quality, that we now have steel which may be used with as much confidence as iron, and which demands no exceptional precautions.

The test standards of the Admiralty and the Classification Societies are too well known to need detailed recapitulation here. They will be found *in extenso* in the Appendix to this Paper. They all consist of tensional tests, supplemented by cold bending tests after heating the samples to a red heat, and suddenly cooling them in water. The Admiralty and Lloyd's superadd to these the requirement of a definite per-centage of elongation before fracture under tensional strain. In the tests made by the Liverpool Underwriters' Registry this elongation is always noted, but no definite per-centage of extension is demanded, reliance being placed on the temper bending tests to show whether the material is of suitable ductility.

The principal difference between the standards of the Admiralty, Lloyd's, and the Liverpool Underwriters' Registry is in the limits of ultimate tensional resistance, the Admiralty requiring that the breaking strain shall lie between 26 and 30 tons per square inch, Lloyd's between 27 and 31 tons, and the Liverpool Underwriters' Registry between 28 and 32 tons.

A material which is stronger than the best iron, and which will double up cold without fracture, has very great charms for the practical shipbuilder. The ductility of such material makes it well suited for the ordinary processes of the ship yard, where neither drilled rivet holes nor careful annealing can as yet be economically practised. Further, since collisions and strandings are constantly occurring, the use, in the hulls of vessels, of a material possessing the very excellent quality of bending without breaking may easily be the means of preventing accidents of this character from ending in total loss.

Such a material is now produced by the steel makers in response to Mr. Barnaby's challenge, and they have practically given us steel plates and bars with qualities "as regular and precise as those of copper and gun-metal."

Having gained this vantage ground, we may fairly look round to see what our next step may be.

The object which ordinary merchant shipowners have in view in adopting steel as a material of construction, is to secure with the same strength a lighter vessel that can be built of iron, and only by this inducement can the greater cost of the material be met. An important increase of tenacity as compared with iron, is therefore a commercial necessity.

So far as the qualities of softness and ductility contribute to the safety of life and property at sea, and so long as they are necessary to dispose of that "fear and trembling" with which steel has so long been regarded, I would be the last to depreciate them. But, while it is admitted that these qualities have made steel a material which with the simplest appliances and ordinary care may be used in any shipyard, it can hardly be claimed for the lower tensional limit of the Admiralty standard, that it provides a material for which important reductions in scantling can be allowed. The tenacity of good iron approximates too closely to that of such very mild steel to warrant any marked difference between them in the scantlings adopted.

This would appear to have been felt by the authorities of Lloyd's, when in 1877 they issued their standard tests for steel with a higher limit of tenacity than the Admiralty scale by one ton per square inch.

The Committee of the Liverpool Underwriters' Registry also felt the necessity of securing greater strength in the material if any important reduction of scantling was to be allowed, and they adopted as their minimum standard of tenacity 28 tons per square inch.

This limit was fixed in great measure out of deference to the Admiralty regulations. Shipbuilding steel is as yet only made at a few establishments, and since Admiralty orders were almost sure to be executed concurrently with orders for the Mercantile Marine, it was manifestly convenient, in aiming at a higher standard of strength, to contrive the limits to overlap; thus material of a tenacity of 28 to 30 tons per square inch would pass both the Admiralty and the Liverpool Underwriters' Registry tension tests, and would also fall within Lloyd's limits. Material of 28 to 31 tons would pass with both Lloyd's and the Liverpool Underwriters' Registry, and incidentally I may note that 27 to 30 tons would pass both the Admiralty and Lloyd's.

Had it not been for this practical convenience, the Liverpool Underwriters' Registry was ready at once to accept 30 tons as the lowest limit of tensile strength.

In the years 1863 and 1864 several vessels were built of steel at Liverpool and elsewhere, under the survey of the Liverpool Underwriters' Registry, and although these vessels were not all built for classification, the material and workmanship were submitted to careful examination. It is admitted that the testing then was neither as extensive nor as systematic as it is now, but the result of experience at that time was that a kindly working and fairly uniform material could be obtained with tension limits of 30 to 36 tons per square inch.

The present testing practice of the Liverpool Underwriters Registry is as follows:—

From every parcel of plates or bars, one in each fifty or fraction of fifty is selected by the testing surveyor as a representative sample. From this plate or bar pieces are cut in the ordinary way for tension and for temper-bending tests; they are taken lengthways or crossways of the plate indifferently, and occasionally in both directions; they are taken from the crop edges and ends of the plates when these are large enough to allow it, so that if the tests are successful the plates are not spoiled for their intended purpose. The tension pieces, after being suitably shaped, are broken in the testing machine. The elastic limit is approximately noted. The breaking weight is carefully observed, pains being taken to see that each increment of load has produced its full effect before the load is further increased. The gross elongation and the fractured area are then measured and noted. The main object of the tensile test is to ascertain the ultimate strength of the material, and to secure that the weakest plates shall at least have a tenacity of 28 tons per square inch.

Temper-bending tests are also made to ascertain whether the material will harden to such an extent under sudden and extreme changes of temperature as to unfit it for the mechanical operations of working into place, and also to ascertain whether the material is capable of withstanding extreme changes of form without fracture.

Though the amount of elongation under tension is noted, it is not considered a matter of very vital importance, because the bending test is itself an elongation test of a very complete kind. If, before bending, a series of equidistant points are marked upon what will be the convex side of a bending sample, and are again measured after bending, it will be found that the distance between them at and about the crown of the bend has materially increased, and that a local elongation has accrued at that point amounting to even 40 or 50 per cent.

In addition to the tensile and temper-bending tests the Surveyor, at his discretion, subjects angles, tees and tee bulbs to opening and closing, and "ram's horn" tests with a view of excluding any material having a tendency to reediness.

I have hitherto referred principally to a *minimum* tensional limit; but general experience has indicated that the stronger the steel the more is it liable to chill and harden, and the less is it capable of extreme changes of form without fracture, so that a *maximum* limit of tenacity has been adopted as an indirect check on the manufacture and use of hard or brittle material.

I submit, however, that this ground is already amply covered by the temper-bending tests, and if these prove satisfactory a *maximum* limit of tension becomes unnecessary: indeed, if the bending tests show the steel to be of satisfactory ductility, the stronger it is the better.

It is sometimes objected by steel makers and others, that the number of test samples selected, and the severity of the tests themselves, materially increase the cost of shipbuilders' steel; in fact, that by protracted and costly experimental tests, which, in addition to limiting the quality of steel available for shipbuilding purposes, are in themselves an important item in the cost of production, the Classification Societies are obstructing the free use of a material which is admittedly superior to the best iron.

So far as this objection implies that we are demanding too good a quality of steel, I have no sympathy with it. A substantial reduction of scantling is claimed on account of the good qualities of steel, and we can only make sure that these good qualities exist by a complete system of testing. As yet we have seen no reason to relax either the number of the representative samples or the severity of the tests themselves.

So far, however, as the objection is directed against a tendency to convert the tests into an experimental investigation, it has my most hearty support. Steel *must* be tested, just as the products of many other manufactures must be carefully examined in comparison with definite standards before they can be issued, but the more we can simplify the examining process the less will be the cost of production.

We have already seen that only two principal tests are necessary upon each representative sample—one a test of tenacity, the other a test of ductility; we have also found that the tenacity test need only have a *minimum* limit, providing it is always accompanied by a sufficient test of ductility. The tests then being directed to one or two specific points, and to these only, it is easy to see that a system of testing might readily be contrived which, while simple to the last degree, should uncompromisingly require conformity to the standards, and be sufficiently extensive to secure complete representation of the whole parcel under examination.

I do not now discuss whether our bending tests should be modified in any degree, though I am aware something may be said in favour of such a course. For the present, I incline to adhere to the familiar Admiralty bending test which has done us such good service.

If I have been fortunate enough to carry you with me as far as I have gone, you will be prepared to accept a *minimum* standard of tenacity without any *maximum* limit. What shall this standard be? At present the Admiralty, Lloyd's and the Liverpool Underwriters' Registry have fixed as their *minima* 26, 27 and 28 tons per square inch respectively. But if we are to secure a quality of material which will allow important reduction of scantlings, and yet retain the stiffness and the strength which we look for in our ships and steamers, we must have a higher tensional resistance than any of the *minima* which I have quoted. Looking over the tension scales of the Admiralty, Lloyd's, and the Liverpool Underwriters' Registry Fig. 1, it will at once be seen that 30 tons per square inch comes within the scope of every scale, and thus carries with it the stamp of approval of authorities whose very nature is caution. That this, and even greater strength, can be produced without any dangerous sacrifice of ductility has been abundantly demonstrated in the daily tests with which we are all more or less familiar; and it is with respectful deference, but with perfect confidence, that I recommend this standard to you for general adoption in shipbuilding material.

APPENDIX.

ADMIRALTY TESTS FOR PLATE, ANGLE, BULB, AND BAR STEEL.

Strips cut lengthwise or crosswise, to have an ultimate tensile strength of not less than 26 and not exceeding 30 tons per square inch of section, with an elongation of 20 per cent. in a length of 8 inches.

The beam, angle, bulb, and bar steel to stand such forge tests, both hot and cold, as may be sufficient in the opinion of the receiving officer to prove soundness of material and fitness for service.

Strips cut crosswise and lengthwise 1½ in. wide, heated uniformly to a low cherry red and cooled in water of 82° Fahrenheit, must stand bending in a press to a curve of which the inner radius is one and a half times the thickness of the steel tested. The strips are all to be cut in a planing machine, and to have the sharp edges taken off. The ductility of every plate, beam, angle, &c., is to be ascertained by the application of one or both of these tests to the shearings, or by bending them cold by the hammer.

All steel to be free from lamination and injurious surface defects.

One plate, beam, angle, &c., to be taken for testing from every invoice, provided the number of plates, beams, angles, &c., does not exceed 50. Steel may be received or rejected without trial of every thickness on the invoice. The pieces of plate, beam, angle, &c., cut out for testing are to be of a parallel width from end to end, and for at least 8 in. of length.

LLOYD'S TEST FOR STEEL USED IN SHIPBUILDING.

Strips cut lengthwise or crosswise of the plate, and also angle and bulb steel, to have an ultimate tensile strength of not less than 27 and not exceeding 31 tons per square inch of section, with an elongation corresponding to 20 per cent. on a length of 8 in. before fracture.

Strips cut from the plate, angle, or bulb steel, to be heated to a low cherry red, and cooled in water of 82° Fahrenheit, must stand bending double round a curve of which the diameter is not more than three times the thickness of the plate tested.

UNDERWRITERS' REGISTRY TESTS FOR STEEL USED IN SHIPBUILDING.

The material is to be tested in the presence of the Surveyor, as in his judgment may appear desirable, both as to tensional resistance and as to cold bending.

Angle, tee, and bulb bars to be submitted to closing, and opening, and "ram's horn" tests, as the Surveyor may direct.

The ultimate tensional resistance of plates and bars to be not less than 28 nor more than 32 tons per square inch. The cold bending test to be as follows:—The sample to be tested to be heated to a full red, and quenched in water, and afterwards bent double cold without fracture, with a curvature of which the inner radius does not exceed one and a-half times the thickness of the plate tested.

The tests to be applied as frequently as the Surveyor may deem necessary, but must not be less than one in every parcel, or in each fifty plates or bars, or fraction of fifty.

If necessary, arrangements may be made for testing the material at the steel makers' works, in the presence of the Surveyor.

BOILER EXPERIMENTS.

An account of some experiments made at the Washington Navy Yard, on the 8 feet diameter cylindrical boiler used with compound engines in several steamers of the United States Navy.

By Chief Engineer ISHERWOOD, U.S. Navy.

As it is necessary in war steamers that the entire machinery be placed below their water line, the height of their boilers in small vessels is, consequently, greatly restricted, and, in many such vessels of the United States Navy, 8 feet were all that could be obtained. When the boilers were to furnish high pressure steam for a compound engine, their shells had to be cylindrical and of this diameter, and it was difficult in so small a circle to obtain a satisfactory arrangement of the furnace and tubes. The plan of boiler finally adopted, is the one shown in the sketch accompanying this paper, and three experiments were made with it at the Washington Navy Yard, by Chief Engineers Loring and Baker, of the United States Navy, to determine the effect upon its absolute and economic vaporizations produced by the two modifications of the tube surface and calorimeter hereinafter described. These experiments are the only ones ever made on the evaporative efficiency of boilers of this type with the given proportions, and as several steamers of the United States Navy are fitted with them, it is of interest, in view of a comparison of the cost of the horse-power developed by their engines in pounds of coal consumed per hour, to know the weight of water vaporized per pound of coal.

An important practical evil of boilers of this small diameter, at once developed when they were put in use, namely, an incorrigible tendency to "prime" or "foam," which required the throttle valve to be nearly always carried very much closed; and, when only a portion of the boilers of a vessel were employed, the smaller that portion, the closer had the throttle to be closed. A very high pressure was thus required in the boiler to furnish a very moderate one in the cylinder, involving all the undoubted disadvantages of high pressure steam, while none of its presumed advantages could be obtained. The excessive strain on the boiler, and the excessive temperature in the fire-room, produced by the high pressure steam, were fully realized; but neither the supposed benefit of a large measure of expansion for this very high pressure could be had, nor the unquestionable benefit of a relatively small back pressure against the piston, due to a high average total pressure upon it during its stroke.

The tubes were secured in the tube-plates by means of screw ferrules of brass 1½ inches long, on the outer circumference of which a thread was cut, fitting into a corresponding thread cut on the inner circumference of the tube. The ferrule at the back end of the tube had a shoulder which fitted against the outside of the tube-plate, the end of the tube fitting against the inside, and forming a shoulder there, so that when the ferrule was turned by means of a wrench on the outside, the shoulders of the ferrule and of the tube, were compressed against the tube-plate. The ferrule at the front end of the tube, for the thickness of the tube-plate, had a diameter greater than the outside diameter of the tube, and on the circumference of this greater diameter, a thread was cut fitting into a corresponding thread cut in the tube-plate: by means of these threads the ferrule was screwed into the tube-plate, while simultaneously it was screwed into the tube by means of the threads previously described cut on the inner circumference of the tube and on the outer circumference of the ferrule where its diameter was least. By unscrewing the ferrules at both ends of a tube, the latter could be drawn out without injury, for examination or cleaning; or for convenience in examining, cleaning or repairing the inside of the boiler shell. This was the purpose of the design, which, however, signally failed in the application, as after a short subjection to the high temperature of the gases of combustion, the fittings were so warped and altered that the screws became inoperative, and the removal of the tubes involved the destruction of both them and the ferrules. This very expensive, useless, and *un*practical method of securing the tubes in their plates, was originally a French invention, and had been tried in the boilers of several French steamers, but its use had long been discontinued before its application to the boilers of any United States Naval steamer.

As regards the experiments, it is regrettable that they were not continued for a longer time than twelve hours each, which is far shorter than desirable for reliable results, although, in their cases, great accuracy of observation was depended on to obviate this objection. That the boiler was not protected with the usual non-conducting covering, is also to be regretted, though the writer has been able to satisfactorily supply the deficiency from other data.

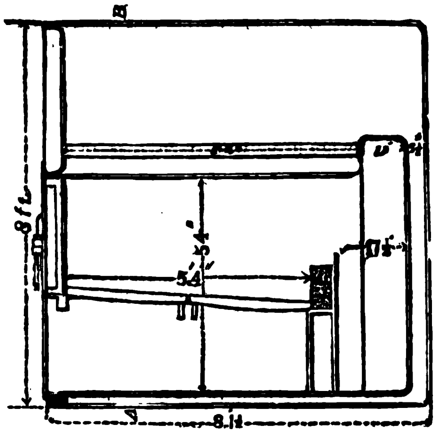
The original notes of these experiments were furnished by Chief Engineer Baker to the writer, who has made the necessary calculations from them, and arranged both data and results in a tabular form, prefacing the table with a description of the boiler and of the manner of making the experiments, and following it with some remarks.

BOILER.

The boiler is of the horizontal fire-tube type with nearly all the tubes returned by the sides of the furnace. It is a duplicate of many in use with compound engines on board of U.S. Naval steamers of a small size.

The shell of the boiler is a cylinder of 8 ft. diameter and 8 ft. 1 in. length, with flat ends. The back end is flush with the end of the shell, but the front end is recessed 4½ in. within the shell. The entire shell is constructed of ⅜th inch thick plate iron, with the joints butted, single welted, and double riveted. The front end serves for the front tube-plate.

Fig. 1.



Longitudinal vertical section through axis of shell, exclusive of uptake.

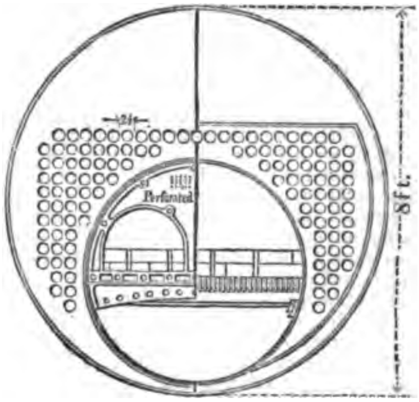
The shell contains a single cylindrical furnace of 54 in. inner diameter and 6 ft. 8½ in. extreme length. It contains a grate 4 ft. 6 in. wide and 5 ft. 4 in. long. The grate-bars are of the ordinary pattern, and are cast in two equal lengths. The grate surface at the front, coincides with the horizontal diameter of the furnace, sloping downwards 4 in. at the back. The bridge-wall is of cast iron, faced with fire-brick 4½ in. thick on the 9 in. it rises above the back of the grate. The bottom of the ash-pit is 4½ in. above the bottom of the shell. The furnace is constructed of ½ in. thick iron in three equal lengths, and has, at each end of the middle length, a stiffening ring inserted of iron 2½ in. deep, ½ in. thick, and 5 ft outside diameter.

The furnace has two doors placed side by side; each door-opening is semi-circular on top, 20 in. wide and 16 in. high. Each door is perforated with eleven holes of 1⅜ in. diameter for the admission of air; and the lining plate is perforated with as many ¼ in. diameter holes as it will contain, for the distribution of this air above the incandescent coal.

The front of the furnace is of cast iron with a double shell; the outer shell is pierced with seventeen holes of 1⅜ in. diameter for the admission of air; and the inner shell is pierced with as many ¼ in. diameter holes as it will contain, for the distribution of this air above the incandescent coal.

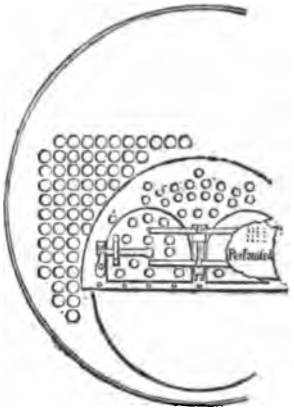
The back smoke connection is 11 in. wide in the clear lengthwise the boiler: it is flat on top, with its sides and bottom concentric with the cylindrical shell of the boiler from which they are separated by a water-space 4½ in. wide including thicknesses of metal. The sides and bottom are, consequently, a segment of a circle 7 ft. 3 in. in diameter. The extreme height of the connection in the clear is 5 ft. 3 in. The back of the connection is flat and parallel to the end of the boiler shell from which it is separated by a water-space 5½ in. wide including thicknesses of metal. The connection is stayed to the boiler shell by socket bolts of one in. diameter spaced every 6 in. The whole of the connection is of plate iron ⅜ths of an inch thick.

Fig. 2.



Half elevation, with uptake and outer plate of furnace front removed. | Half cross section on *A B*, Fig. 1.

Fig. 3.



Front elevation exclusive of uptake.

The tubes, with the exception of those of the upper row, twenty-one in number, are divided into two equal and symmetrical groups, one of which is returned on each side of the furnace from the back smoke connection to the uptake, completely filling the spandrels between the furnace and the boiler shell. Of these tubes, sixteen (eight on each end) lie below the level of the top of the bridge-wall, and six (three on each side) lie just at the level of that top. The upper rows of tubes lie unbroken above the furnace.

The tubes are of brass and seamless, and are secured to their plates by screw ferrules of 2 in. inside diameter. Each tube is

2½ in. 2·3 in. in inside diameter, in outside diameter and 6 ft. 4 in. in extreme length to outside of tube-plates. They are 119 in number. The object of the screw ferrules was to allow the tubes to be removed for cleaning without injury, and to be replaced quickly. The distance between the axes of the tubes, horizontally is 3½ in.; and, vertically, 3·2 in.

Above the tubes, the flat ends of the boiler shell are stayed together by eighteen rods of 1¼ in. in diameter: these rods pass through the flat ends, to which they are secured by collars on the inside and nuts on the outside. The rods average 8¼ in. from centre to centre.

The uptake is a separate construction of sheet iron placed against the front end of the boiler, which is nearly covered by it, with the exception of the front of the furnace and ashpit. It has the usual doors, hinged at top and giving access to the tubes for sweeping, &c. The chimney rises from the top of the uptake.

During the experiments, the boiler had no covering of any kind.

The following are the principal dimensions and proportions of the boiler.

Diameter of the shell	8 ft.
Extreme length of the shell	8 ft. 1 in.
Number of furnaces	1.
Width of the grate	4 ft. 6 in.
Length of the grate	5 ft. 4 in.
Grate surface	24 square ft.
Number of Tubes	119.
Outside diameter of tubes	2·5 in.
Inside diameter of tubes	2·3 in.
Inside diameter of ferrules for tubes	2·0 in.
Length of tubes in the clear between the tube plates	6 ft. 2¾ in.
Height of the chimney above the grate surface ...	59 ft. 6 in.
Diameter of the chimney connection	2 ft. 1½ in.
Cross area above the bridge-wall for draught ...	6·0945 sq. ft.
Cross area through the tubes for draught ...	3·4334 sq. ft.
Cross area through the ferrules of the tubes for draught...	2·5962 sq. ft.
Cross area of the chimney connection	3.5465 sq. ft.
Heating surface in the furnace	48·6 sq. ft.
Heating surface in the back smoke connection ...	64·0 sq. ft.
Heating surface in the tubes, calculated for their inner circumference	446·4 sq. ft.
Heating surface in the uptake	14·0 sq. ft.
Total heating surface in the boiler	573·0 sq. ft.
Square feet of heating surface per square foot of grate surface	23·875
Square feet of grate surface per square foot of cross area above the bridge-wall	3·938
Square feet of grate surface per square foot of cross area through the tubes	6·990
Square feet of grate surface per square foot of cross area through the ferrules	9·244
Square feet of grate surface per square foot of cross area of chimney connection	6·767
Water room in boiler to 6 in. above top of tubes ...	100 cub. ft.
Steam room in boiler above 6 in. above top of tubes	75 cub. ft.
Weight of boiler, exclusive of grate bars and chimney	22100 pounds.
Weight of grate bars...	1210 pounds.
Weight of water in boiler	6233 pounds.

(*To be continued.*)

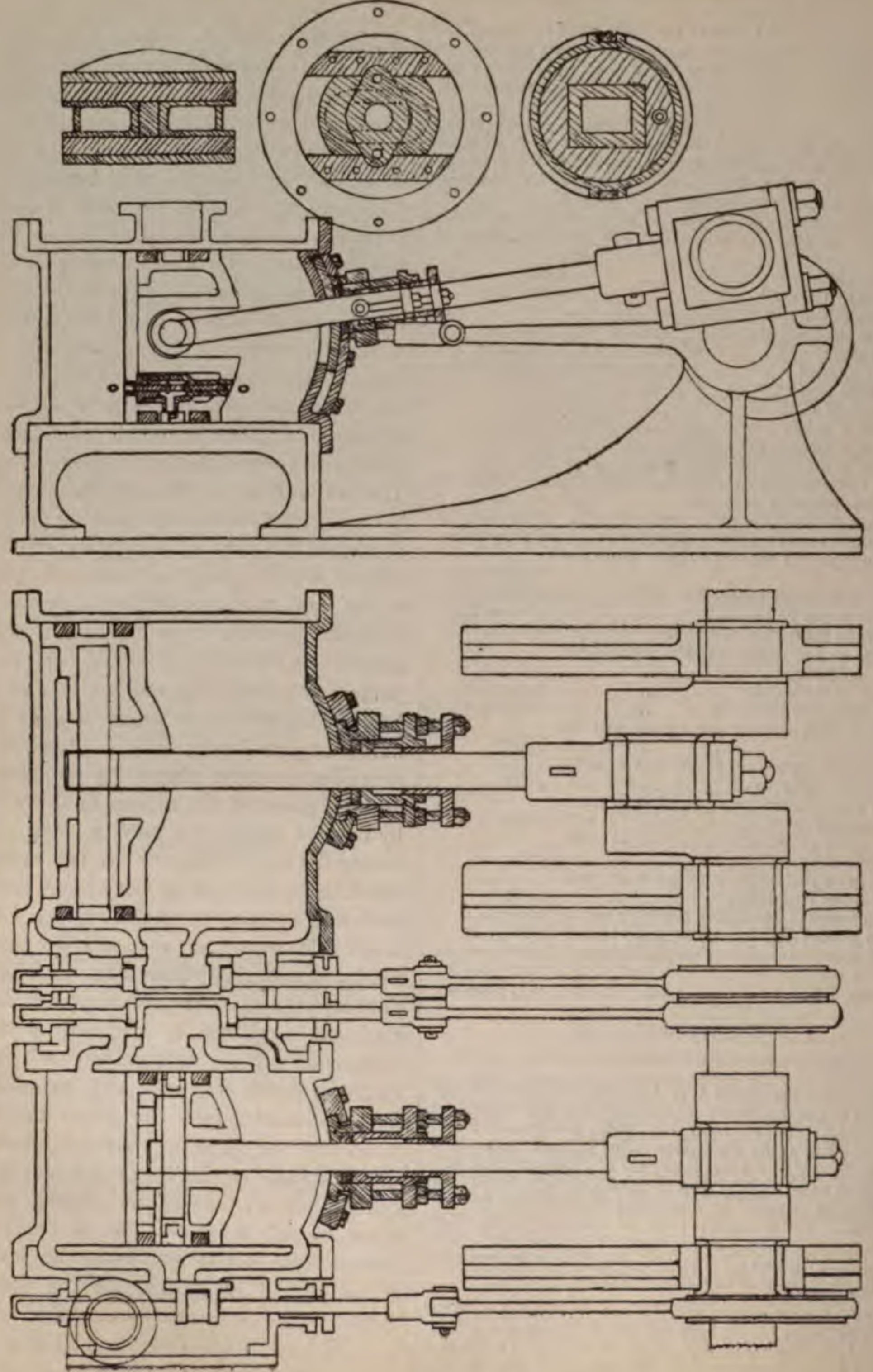
A NEW ship for the use of the War Department, of much larger dimensions than any of the vessels at present employed in furnishing supplies to the home stations from Woolwich, has been built at Glasgow, and is nearly ready for service. She has been named the *Stanley* in compliment to the late Secretary of State for War, and has been designed with a special view to great carrying capacity, as she will probably be required to carry guns of the largest type to the ironclads which are to receive them in the dockyards. Her engines, which are now being pbt in, are on an improved principle, and are calculated to insure a fair speed. The ship is expected to arrive at the Royal Arsenal, Woolwich, in July.

THE *Flying Fish*, 4, composite screw sloop, 894 (727) tons, 836 (120) horse-power, after having been refitted in Sheerness Dockyard, was floated into the harbour on April 26th. At 12 o'clock she went out for a three hours' run over the measured mile at the Maplin Sands. The *Flying Fish* was recently commissioned at Sheerness for surveying service on the China station. The trial was very satisfactory. The ship was in charge of the Medway Steam Reserve officials and Mr. J. Stephens, the chief engineer.

IMPROVED COMPOUND CYLINDER ENGINE.

FOR increasing the economy of steam and simplifying the construction, many ingenious arrangements have been made to simplify and obtain a good rotary engine to supersede the reciprocating engine, and work with greater economy and diminished wear, but great practical difficulties have prevented their success and adoption. Reciprocating engines have been greatly simplified and improved to lessen the parts and obtain a more direct motion to the crank, which renders them more light and portable, and gives them great advantages over the older type of engines made with beams, side levers, &c. The oscillating engine is a good example of direct acting engines, when applied to paddle-wheel steamers, or stationary purposes, but the great weight of the cylinder in motion is against its use for propelling ocean steamers fitted with screw propellers at the great speed they work. The extra gear for neutralizing the motion of the cylinder, and indirectly working the steam valves, enhances the cost of oscillating engines. The trunk engines with the great frictional and eradiating surface of the trunk causing great loss of heat and condensation of steam, prevents it as a direct acting engine, from superseding the ordinary marine engines for screw propelling, with connecting rod, &c., and the limited distance between the side of the vessel and the screw shaft, for fixing engines horizontally in ocean or war steamers, necessitates a short connecting rod, and diminishes the effective power of the engines by the acute angle formed by the rod against the motion bars. And in engines having the connecting rods on the opposite side of the crank shaft, with two or more piston rods, increases the cost and complexity of the engine, without obtaining much additional length of rod for the reduction of friction against the motion bars. The defects and objections referred to in the various type of engines enumerated, are overcome by the improved direct acting compound engine, recently patented by W. Turnbull, Engineer, which dispenses with connecting rod, motion bars, &c., and couples the piston and crank together, direct from the piston rod, through a moveable stuffing-box that works steam-tight on the convex surface of the cylinder cover, having an oblong opening in the cover to suit the oscillation of the piston rod; the pressure and friction that would result from the angular thrust of the piston rod on the piston is counteracted by admitting steam between the piston and cylinder by a small self-acting valve on the side where the pressure acts. The cranks of each cylinder are fixed at right angles to each other, and each cylinder has communication with the condenser. The steam from the boilers

IMPROVED COMPOUND CYLINDER ENGINE.



is supplied to the small cylinder by a small plate, or block valve, worked from a separate link motion, which regulates the steam required in the cylinder when the piston of the small cylinder has traversed part of the stroke. The steam is transmitted by an intermediate valve, working in concert with the steam valve in the chest, between the cylinders from the pressure side small cylinder piston to the pressure side of large piston. When the small piston has passed the centre and traversed about one-tenth of the return stroke, the large piston having performed about four-fifths of the stroke, each valve having reclosed their steam ports, the remaining steam in small cylinder is exhausted to the condenser by the intermediate valve; the intermediate and steam valve of large cylinder work in unison from separate link motions always at full through. In moving the engines the valves can be worked together from the same lever and reversing shaft, or the valve of small cylinder can be worked separately. In this plan of engine, the same indicated horse-power can be obtained with 15 to 20 per cent. less steam, the capacity of cylinders and pressure of steam being the same as in ordinary compound engines with cranks at right angles.

By this type of compound cylinder engine, the same economy of steam is obtained when the cylinders are of equal diameters, or with the diameters of the cylinders arranged to equalize the strain on each crank, which cannot be done with the ordinary compound engine, without greatly decreasing the economy of the steam.

The advantages claimed by the inventor, Wm. Turnbull, of this class of compound cylinder engines are as follows:—A more simple constructed engine, having fewer working parts than ordinary engines; less friction and wear; a more efficient transmission of steam to large cylinder; the maximum pressure from small cylinder being in the chest at the commencement of the stroke of large cylinder; greater economy of steam from increased effective pressure of steam in small cylinder by vacuum; increased expansion of steam in cylinders of equal capacity; compared with ordinary compound engines; a much longer connecting rod to crank than ordinary engines with cylinders at equal distance from the screw shaft.

NEW DOCK AT HULL.—A dock, which was named the William Wright Dock, after the late chairman of the Hull Company, Sir William Wright, was formally opened, May 25th, by the present chairman. Lieut.-Colonel Pease arriving at the new dock in the company's steamer *Active*, a party landed, and the chairman turned on the hydraulic power to open the caisson at the entrance. They re-embarked and steamed into dock in the tug, followed by the steamer *Essex*, a Baltic trader. The dock gives nearly six acres additional water space, besides a large modern graving dock, 460 ft. long. The chairman stated the works had cost more than a quarter of a million, and on an uncompleted dock further to the westward, which would shortly be completed, £400,000 had been expended. This dock would give 22 acres additional water space. A warehouse has been completed at the new dock capable of storing 50,000 qrs. of grain.

HEAT SCREEN FOR STOKE HOLES.

WE are glad to be able to give the greatest possible publicity to a new invention for protecting the firemen and engineers from the oppressive heat experienced in stoke holes which becomes injurious and unbearable in tropical latitudes. The arrangement we illustrate is the invention of a Russian engineer, and is extremely cheap and simple.

The apparatus consists of a screen of linen, cotton tissue or other fibrous material which is hung from an iron rod in front of the boilers. Along the top of the screen runs a finely perforated pipe which is supplied with water from a pump or tank, the water falling on the screen and thoroughly wetting or saturating it. The radiant heat from the boilers evaporates the water screen and is thus absorbed, preventing the passage of the heat through the screen and keeping the atmosphere cool.

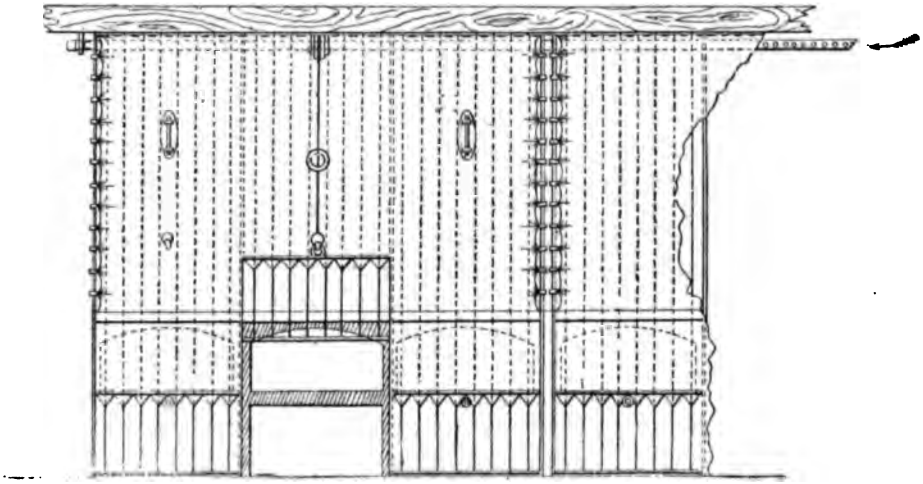
By actual experiments, made by the Torpedo Department of the Russian Navy, it has been proved that the temperature of the stoke-hole was reduced from 113 deg. to 66 deg. We understand that these screens will be introduced into the Russian Marine in the course of this season.

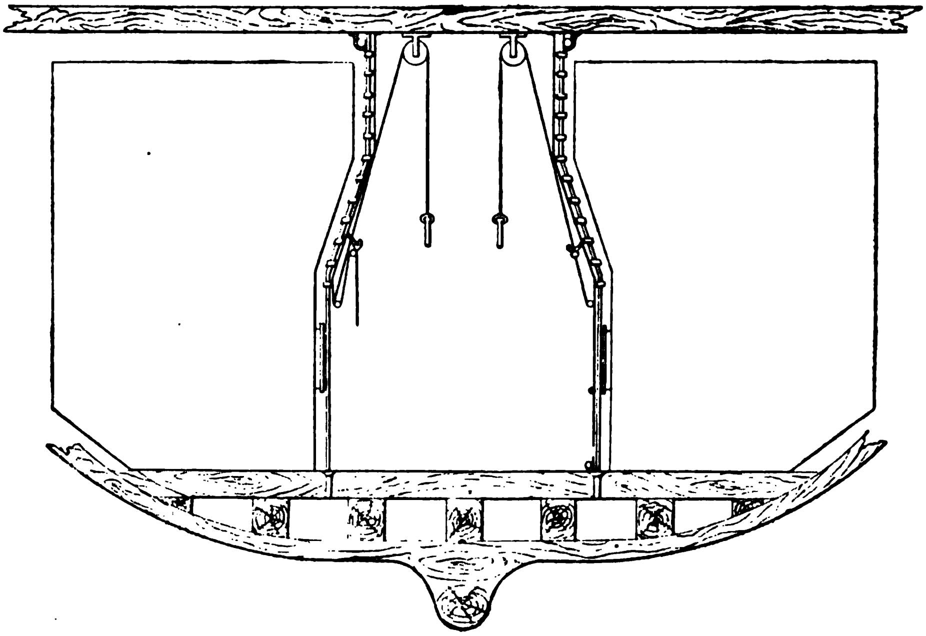
The lower edge of the screen is attached to a rod with side guide rods and rings so that it can be raised by pulleys and cords. Small openings are made opposite to each fire-door to which are fitted supplementary screens which can be raised as required for firing. The screens are fitted with hooks at the bottom edges so that they can be hooked up out of the way when desired. The lower edges of the screen terminate in vandyked points so as to allow free ingress to the air to supply the furnaces. Down the whole inside surface of the screen to each vandyked point run small cords to direct the falling streams of water, and the excess water will pass quietly away down the cords to the floor, and thus to the bilge without dropping or splashing. Openings are cut in the screen opposite to the gauge glasses, cocks, and other parts of the boiler to which frequent access is required.

In practice it has been found that the most satisfactory cooling of a boiler room, say with 8 boilers, can be effected by a discharge of about 100 to 150 gallons of water per minute, requiring a mechanical force of less than 2 horse power.

That this cooling apparatus would prove a priceless boon cannot be doubted, and no doubt tend to much more careful and frequent inspection of the state of the boilers by the engineers who are now rather apt to shirk that duty from the insufferable temperature of the stoke hole. We understand that this invention is in the hands of Mr. J. C. Fell, M.I.M.E. of the City Patent Office, 23, Rood Lane, E.C., for commercial introduction into this country.

HEAT SCREENS FOR STOKE HOLES.





ON SIMPLE AND COMPOUND ENGINES.

III.

IN our former articles we have discussed the causes which make the compound engine more economical in consumption of fuel than the simple engine, and we now come to consider some other points besides economy which have helped the compound system to supersede the simple for marine purposes. As these points refer to the manner in which the various parts of the machinery become strained by the steam performing work, and also to the steadiness or otherwise of the motion produced, we cannot do better than again compare the engines we have previously examined when considering the question of economy.

The compound engine has cylinders of 36 and 64 inches diameter and 42 inches stroke; the diagrams of these engines are shewn in figs. 2 and 3, and they shew that with 58 revolutions per minute the total indicated horse-power is 770.

Taking the same simple engine diagram as before, and supposing the engine to have the same stroke and piston speed as the compound one, we find that to indicate the same power we shall require two cylinders, 50 inches diameter, and these two pair of engines will now be strictly comparable as regards the strains on the mechanism and also the smoothness and uniformity of the motion.

Fig. 1 represents the indicator diagram of each cylinder of the simple engine, fig. 2 that of the high pressure, and fig. 3 of the low pressure cylinders of the compound engine.

In order to evolve any given amount of power it is of course necessary that the mechanism by which the power is produced, and also that by which it is transmitted, shall be strained to an extent depending upon the amount of the power, and which on the average or mean will be exactly proportionate to the power so produced and transmitted; but the actual straining actions themselves, at any given instant, may be capable of very extreme variations, at one instant being much greater and at another much less than the average. We may therefore consider that, other things being the same in the two cases, the mechanism in which the greatest strain is little or no greater than the mean, is much more satisfactory than one in which the strains are at times more variable and violent.

In an engine the strains at any instant on the piston, piston rod, connecting rod, top and bottom end bolts, the main bearing bolts, and also on the cylinder cover or bottom, are proportional to the effective pressure on the piston, that is, to the difference between the forward pressure on the one side and the backward pressure on the other, and as this pressure varies very much during each instant of the stroke, it follows that the strains on these parts are also varying. A glance at the indicator diagrams in figs. 1, 2 and 3 will shew that in the simple engine the maximum pressure on the piston exceeds the mean pressure in a much greater degree than in either the high or low pressure engines on the compound system, and hence we must conclude that all these details of the engine, and very important details they are, must be made much stronger and consequently heavier, to do the same amount of useful work in the simple than in the compound engine, if we wish to make the one as free from breakdowns as the other. And it must be borne in mind that additional weight in most of them parts means additional work to be performed in moving these to and fro every revolution of the engine, and also means additional friction to be overcome in the engine itself, and more wear and tear of the machinery.

Let us now look at the case of other important parts of the machinery, viz., the shafting and propeller.

In fig. 4 is shown the twisting strain brought to bear upon the shafting in the simple engine. The straight line at the lower portion of the diagram represents the position of the crank at any point of the revolution starting at the top centre; the distance of each dotted line from this straight line is proportional to the strain brought by each engine on the shaft. As one crank is 90° in advance of the other, the one engine is at nearly midstroke, while the other is on the dead centre, and consequently while one engine is exercising no turning effort on the shafting, the other is at its most advantageous position for turning the engines. The upper irregular plain line represents the action of the two engines combined, the height of it being at any point equal to the sum of the heights of the dotted lines. The straight line marked *mean* is the average of these twisting efforts, and is of course proportional to the power of the engines or to the useful work done.

It will be seen from this diagram that during one revolution of the engines, the actual strain exceeds the mean on four different occasions, and also falls below it on four occasions. At its greatest value it is 70 per cent. in excess of the mean, while at its lowest it is only about one halt of the mean. From this it follows that the shafting and propeller for this engine will require to be made 70 per cent. stronger than would have been needed if the power could have been developed perfectly uniformly, while at some instants these parts of the machinery will only be required to sustain about one-third of the strain that falls upon them at other times.

The corresponding diagrams of the Compound Engine are shewn in fig. 5. In this diagram it is seen that in some cases, viz., nearly at the end of the stroke in the high pressure cylinder, the line representing the turning effort of this cylinder falls below the base line; this indicates that at these portions of the revolution the high pressure engine is tending to retard the engine, the compression or back pressure at these instants being greater than the forward pressure on the piston. In this case it will be observed that the greatest strain is only 30 per cent. in excess of the mean, and also that the strain never falls to so low an amount as in the former case, so that we see a much lighter shaft, &c. are required in this engine to do the same amount of useful work.

The other point requiring attention is the effect of the varying steam pressure upon the uniformity of motion. In order to have a perfectly steady motion of any machine working against a uniform resistance, we must have the power exerted also steady. If at any time the power exerted exceeds the resistance, only so much of the power as overcomes the resistance is used up, the residue being expended in accelerating the machinery, while if at any time the power is less than the resistance, the mechanism moves slower, and by its reduction of speed gives up to the resistance the amount of energy necessary to overcome it; or if the machinery has not sufficient energy stored in it by its inertia and speed, it will come to a dead stop. This is the principle of the fly wheel as applied to single acting engines and other machinery in which the motion would otherwise be irregular, and the same principle is also illustrated by the racing of Marine Engines during heavy weather, in which the motion of the waves by more or less uncovering the screw lessens the resistance, and the engines consequently become accelerated or *race*.

In applying this principle to the cases before us, we find that during the whole of the portion of the revolution in which the strain exerted by the engine exceeds the mean strain, that is, while the curve falls above the mean line, the engines will become accelerated or will move above their mean speed, while during the time that the curve falls below the mean line they are correspondingly retarded; it follows then that the times of maximum velocity are those corresponding to the positions where the curve cuts the mean line as it passes from above to below it, and the times of minimum velocity to those positions where the curve cuts the mean line as it passes from below to above the line.

On referring to our diagrams in figs. 4 and 5 it will be readily seen that the motion in the compound engine must be more uniform than that in the simple engine.

There is another motion of the machinery, which is one that is not at all desired, but which is always present in a greater or less degree, viz., vibration. This motion which is due to a want of rigidity either of the engine as a whole, its fastenings to the hull of the vessel, or of the hull of the vessel itself, or possibly to more than one these, is always produced by the forces acting within the engine, and the more uniform and steady these forces are the less will the vibration be. In the simple engine with its early cut off we have seen that the pressure on the piston at the commencement of the stroke is greatly in excess of the mean, and still more exceeds the pressure towards the end of the stroke; this produces very varying strains on the piston and connecting rods, bolts &c., and as these parts of the machinery are not rigid, but on the contrary, in common with all metals, alter their shape to a slight degree with the forces brought upon them, we have a vibration or motion necessarily set up in these parts, which vibration is communicated to other portions of the structure, and is greater the greater the variation of the strains. This vibration alone in a large pair of engines, made upon the simple plan with high steam pressure and very early cut off, was sufficient to cause very grave anxiety when working at high speeds, and would have required special precautions had not other considerations necessitated the replacement of these engines with compound ones.

We have in the limited space at our disposal briefly glanced at some of the causes which have tended to make the compound engine supersede the simple for marine purposes, the principal of these being its great relative economy in coal consumption, but other reasons, some of which we have indicated, and which many of our practical readers will be able to amplify from their own experience, have had an influence in the same direction although not to so great an extent as the effect of economy. What the future of the marine engine is to be we cannot say, but there is no reason to doubt that progress will still be made, surely if slowly, and although the coal consumption has now been reduced to so great an extent that in short voyages made at comparatively low speeds, the coal account is so small a portion of the total expenses, that a great reduction of it would not very much economize the cost of cargo carrying, yet it would be of the greatest importance in fast steamers making long voyages, and would no doubt open up new trades and revolutionize old ones as regards the speed of the vessels engaged in them.

SIMPLE AND COMPOUND ENGINES.

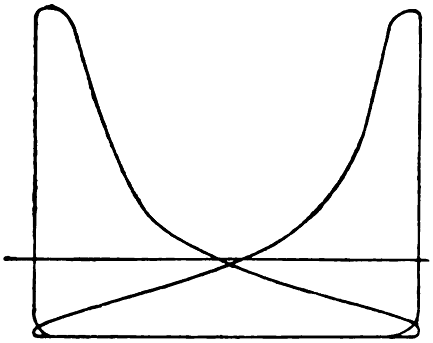


Fig 1.—30 *lbs.* = 1 *in.*

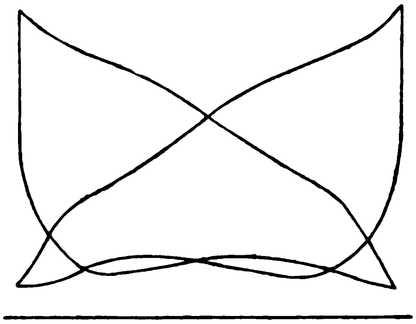


Fig. 2.—40 *lbs.* = 1 *in.*

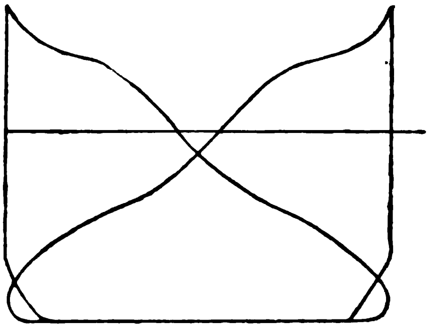


Fig. 3.—12 *lbs.* = 1 *in.*

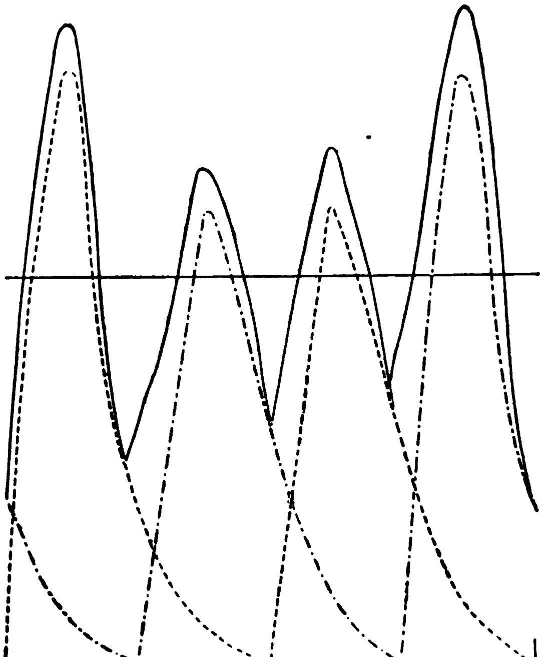


Fig. 4.

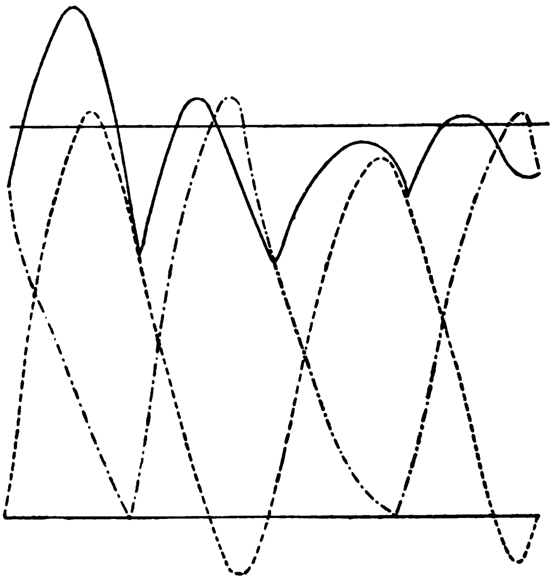


Fig. 5.

- - - - - - - *Shews the twisting strain exerted by the Forward Engine.*

. . . . - - - - - - - - *After do.*

——— - - - - - - - *Both engines acting together.*

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

William Hartmann.—On the 22nd April, a steamer named the *William Hartmann* was launched by Messrs. Schlesinger, Davis & Co., from their building-yard at Wallsend. The leading dimensions of this vessel are as follows:—Length between perpendiculars, 235 ft.; breadth moulded, 31 ft.; and 18 ft. 6 inches depth of hold. She has been constructed so as to secure the highest class in the Liverpool registry—namely, 20 years in red. The vessel has a long half poop extending over engine and boiler room; the main cabins are aft; the officers and engineers are berthed amidships, and provision is made for the crew under a topgallant forecastle, on the top of which is placed one of Harfield's steam windlasses. A large, double-powered steam winch is fitted to each hatch, to facilitate the loading and discharging of cargo. The engines, which are compound-surface condensing, have cylinders 28 inches and 53 inches diameter, and a stroke to each of 36 inches will be supplied by Messrs. Thomas Clarke & Co., of Elswick. The vessel has been constructed for Messrs. Ward & Holzapfel. The ceremony of naming the vessel was performed by Mrs. Holzapfel, the daughter of Mr. G. W. Ward and wife of Mr. Holzapfel. The *William Hartmann* will be commanded by Captain Simpson.

St. Gothard.—On April 24th a steamer was launched from the building yard of Messrs. Redhead & Co., South Shields. The new vessel, which was named the *St. Gothard* by Mrs. Purvis, of Hughhead, near Berwick, is 255 ft. long. 34 ft. beam, 23 ft. depth of hold, built on the three deck principle, to be classed 100 A 1 at Lloyd's. She has iron decks, and is fitted with water ballast tanks throughout, and will have steam winches, windlass, and all the latest improvements. Her engines, which will be put in by Messrs. Redhead and Co., are to be of 150 nominal horse power. The accommodation for the crew is to be on deck. She has been built to the order of Messrs. Hall, Cay & Co., South Shields, and is destined for the American and general trade.

Howards.—On April 24th there was launched by Messrs. Osbourne, Graham, & Co., from their yard at Hylton, an iron screw steamer 225 ft. long, 32 ft. beam, and 16 ft. depth of hold built to the order of Mr. John F. Marshall, of Sunderland. The vessel is built with long raised quarter deck, bridge, house over engine and boiler room, and topgallant-forecastle, will be classed 100 A 1 at Lloyd's, and be fitted with compound engines by Mr. G. Clarke, Southwick, with cylinders 28 in. and 53 in., and 36 in. stroke, with large boiler power. Provision is made for facility in discharging and loading by large hatchways and three powerful steam winches, and the vessel has been fitted with all modern appliances. Both hull and engines have been built under Lloyd's special survey. On leaving the ways she was named the *Howards* by Mrs. Marshall.

Sierra Estrella.—On the 26th April an iron sailing ship was launched from the building yard of Messrs. Richardson, Duck, & Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length over all, 251 ft.; ditto, b. p., 232 ft. 3 in.; breadth (extreme), 37 ft. 9 in.; depth in hold, 22 ft. 7 in.; tonnage, O.M., 1,588 tons; gross, N.M., 1,499 tons. She is classed 100 A 1 at Lloyd's, and 20 years in the Liverpool Registry, but is considerably stronger than required by their rules. She has a full poop for the accommodation of the captain and officers, and a topgallant forecastle for the crew. She will be rigged as a ship, and is fitted with one of Harfield's patent windlasses. The vessel has been built to the order of Messrs. Thompson, Anderson & Co., Liverpool, and is intended for the Indian and China trades. As she was leaving the ways she was christened the *Sierra Estrella* by Mrs. Reid, wife of Captain William Reid, of Liverpool.

Laleham.—On the 26th April there was launched from Palmer's yard at Jarrow, the iron screw steamship *Laleham*, built for Messrs. J. Temperley & Co., Newcastle. The steamer measures 296 ft. in length, 35 ft. in breadth, and 24 ft. 3 in. depth. She is classed 100 A 1, the highest class at Lloyd's, and will carry a cargo of about 3,000 tons dead weight. The decks are constructed of iron, the upper deck being sheathed with wood. The *Laleham* will be of 200-horse power nominal, and is intended for the Atlantic and general trade. The vessel will be commanded by Captain Reynolds, late of the screw steamer *Farnley*. The ceremony of naming the *Laleham* was performed by Miss Jackson, of Hexham.

Freda.—On the 26th April a racing yacht was launched from within a stone-throw of Old Battersea Bridge, on the Thames. She is named the *Freda*, and is owned by Mr. T. G. Freke, of Grosvenor Gardens. She is a notable addition to the 20-ton racing class, and the whole of her ballast (17½ tons) is carried on the keel. The new yacht will make her first racing essay in the Royal Thames Yacht Club races this month.

Akaba.—On the 26th April Messrs. M. Pearce & Co. launched from their iron shipbuilding yard at Stockton an iron screw steamer of the following dimensions:—Length between perpendiculars, 300 ft.; extreme breadth, 36 ft.; depth of hold to top of floors, 25 ft. 6 in. This vessel is about 2,300 tons gross register, and will carry about 3,300 tons deadweight, at about 22 ft. draught of water. She is built at the highest class granted at Lloyd's. She has a full poop aft, in which is fitted a handsome saloon with passengers' and officers' accommodations, and other officers. This vessel is built off the three-decked rule, with two decks laid, both being of iron. She will be rigged as a three masted schooner, and will carry double topsails on her foremast. She will be provided with engines on the direct-acting, self-condensing principle, of 280-horse power nominal, from the well-known establishment of Messrs. Blair & Co., of Stockton, four steam winches, patent steam steering gear, has double bottom for water ballast, and all the most recent and improved appliances for expeditiously loading and discharging cargoes, and for ventilating and other sanitary purposes. This is the second vessel Messrs. Pearce & Co. have built for her Owners, for whom also they expect to launch a sister ship in the course of a month or six weeks. The christening ceremony was gracefully performed by Miss Pearce, the name given of the vessel being *Akaba.*

Goodwood.—On 27th April, Messrs. John and William Harvey, shipbuilders, launched from their shipbuilding yard at Climping, Littlehampton, a barque of the following dimensions:—Length, 149 ft.; beam, 29 ft.; depth, 18 ft.; tonnage, N.N.M., 568; classed 17 years A 1. On leaving the ways the new ship was named the *Goodwood* by Miss Rayner, of Swansea, sister to Mrs. John Harvey. She has been purchased by Mr. A. W. Halden, of Swansea, and is intended for the South American trade.

Cherubini.—On the 27th April, Messrs. Short Brothers launched from their iron shipbuilding-yard at Pallion, Sunderland, a screw steamer for Messrs. Jennison, Taylor & Co., of Sunderland, of the following dimensions and particulars:—Length, 260 ft.; breadth, 36 ft., and 2 ft. 6 in. in depth of hold; and classed 100 A 1 in Lloyd's Registry, under special survey. She is fitted with an iron upper deck, and arranged in the 'tween deck for a deck being laid when required. Every attention has been paid in the arrangement for quick loading and discharging of cargoes, having four large hatchways, with a large steam winch at each. The vessel has water ballast in both holds, and is to be fitted with engines of 180-horse power, by Mr. John Dickenson, of Monkwearmouth, with all the latest improvements. On being launched the vessel was named the *Cherubini.*

Inchmaree.—On April 28 a screw steamer, built to the order of Messrs. Hamilton, Frazer & Co., of Liverpool, was launched from the yard of Messrs. C. Mitchell & Co., Low Walker. She is of the following dimensions:—Length, over all, 294 ft.; breadth, 36 ft.; depth, 24 ft. 6 in. The vessel is built to the highest class at Lloyd's, but is even stronger than required by that society. She will carry 3,000 tons dead weight, and in her construction all recent improvements have been introduced. The vessel was named *Inchmaree* by Miss Annie Heslop.

John Chagot.—On May 6th the *John Chagot* (*s*) was launched from the yard of the Palmer Shipbuilding Company, Jarrow. She is a vessel measuring 230 ft. between perpendiculars; 32 ft. breadth, moulded; and 17½ ft. depth of hold. She is classed 100 A 1 at Lloyd's, being built under special survey. She will be schooner rigged, and have a long, raised quarter-deck. Her engines will 130-horse power nominal, and manufactured by Messrs. Palmer.

Barnesmore.—On May 8 the screw-steamer *Barnesmore* was launched by Messrs. Thomas Royden & Sons, Queen's Dock, Liverpool. She is a vessel of about 2,000 tons, and has been built to the order of Messrs. William Johnston & Co., to trade between Liverpool and the Danubian ports. Her principal dimensions are:—Length, 260 ft.; breadth, 34 ft.; and depth of hold, 18 ft. 6 in. This steamer, which is classed for 20 years in the Liverpool book, will be supplied with engines of 150-horse power, constructed by Messrs. Jack & Co., of the Victoria Engine Works, Liverpool. The christening ceremony was performed by Mrs. Edmund Johnston, wife of one of the owners, and after the launch the vessel was towed to the Sandon Dock, where she will receive her machinery.

Elfie and Gulf of Suez.—On the 8th May, Messrs. W. Gray & Co., launched at West Hartlepool two screw steamers. The first was to the order of Messrs. Neilsen & Co., West Hartlepool, and was christened the *Elfie*. She measures 235 ft. in length, 32 ft. breadth, and 17 ft. and 21 ft. depth of hold. Her gross tonnage is 1,250, and her carrying capacity 1,600 tons. Her engines will be 110-horse power, and are to be supplied by Messrs. Blair & Co., Stockton-on-Tees. The second was to the order of the Greenock Steamship Company. Her dimensions are:—260 ft. length, 34 ft. breadth, and 23 ft. 3 in. depth of hold. The gross tonnage is 1,570 tons, and she will class 100 A 1 at Lloyd's as a three-decker. Her engines, which are 150-horse power, will be by Messrs. Blair & Co., of Stockton, and she will form one of the line trading out of the Clyde. She was christened the *Gulf of Suez* by Miss Newton.

Adelaide.—On the 8th May, the *Adelaide*, a steel paddle steamer, intended for the Great Eastern Railway Company's Harwich route to the Continent, was launched from the yard of the Barrow Shipbuilding Company. The christening ceremony was performed by Mrs. Simpson, the wife of Mr. Lightly Simpson, one of the directors of the Great Eastern Railway Company. The dimensions of the *Adelaide* are:—Length 260 ft., beam 32 ft., with a gross tonnage of 960 tons, and accommodation for nearly 200 passengers. She is fitted with compound oscillating surface-condensing engines of 1,600 indicated horse power. She is expected to be running between Harwich and the Continent next month.

Ville de Bone.—On the 8th May the *Ville de Bone* the second of the two passenger mail steamers now being built by Messrs. Wigham Richardson & Co., at the Neptune Works, Low Walker, was launched. She is being built to the order of the Compagnie Generale Transatlantique of Paris, is 320 ft. long, 33½ ft. broad, by 25¼ deep. There are eight more of those steamers now being built in three of the largest yards on the Clyde, and they are all expected to be ready for service by the end of June. They are intended for mail and passenger service between Marseilles and Algiers.

Albert Victor.—On May 10th the *Albert Victor*, steel paddle-wheel steamer, was launched from the building establishment of Messrs. Samuda Brothers, Poplar. This vessel has been built by them for the South Eastern Railway Company for the service between Folkestone and Boulogne, and will surpass in speed all the other Channel steamers now afloat. It has been constructed of steel manufactured by the Siemens process, the effect of which has been to render possible a great reduction in the weight of the hull, and at the same time to retain the most perfect strength of structure. At a speed of 18 knots an hour the *Albert Victor* will perform the passage from Folkestone to Boulogne in an hour and a quarter. The engines, by Messrs. Penn, of Greenwich, are of 2,800-horse power, and will be fitted with steam starting gear and other recent improvements. The vessel's principal dimensions are —Length, 250 ft., breadth, 29 ft., depth, 15 ft. 6 in., burden in tons, builders' measurement, 1,040 tons. The whole fore part of the vessel is covered by a light hurricane deck. The numerous visitors invited to the launch of the *Albert Victor* were conveyed in two special steamers from the Speaker's Stairs to Poplar, where a less distinguished crowd had assembled to see the christening of the vessel and its launch by the Princess Mary of Teck. On the arrival of her Royal Highness and the Duke of Teck, the customary bottle of Champagne was broken over the bows of the vessel, and when all was ready the last cords that supported the dogshores were cut through by the Princess with a golden chisel, and the *Albert Victor* glided without delay or accident into the river. Immediately after the launch a *dejeuner* was given in a well-disguised and decorated workshop to about 100 guests, including, besides the Royal party, the Earl and Countess of Wharncliffe, *the Earl of Cork,* Lord and Lady Auckland, the Earl of Ravensworth, Sir H. J. Tufton and Lady Tufton, the Dean of Canterbury, Mr. A. Gathorne-Hardy, and many of the directors of the South Eastern Railway. Sir E. Watkin, M.P., was in the chair. The health of "The Queen" having been duly honoured, Sir E. Watkin proposed "The health of the Princess Mary of Teck," thanking her cordially for her presence on that occasion, and expressing a hope that both the English and the French harbours would soon be improved for the reception of vessels capable of making the Channel passage in no more than an hour. In the meantime, however, all that could be done was to build vessels like the *Albert Victor*. The Duke of Teck responded to the toast, and proposed "The health of Mr. Samuda and Mr. Penn." Other toasts followed, one of them being "The Health of the Directors of the Chemin de Fer du Nord," for which MM. Griolet & Mathias returned thanks. M. Griolet remarked that France was as much interested as England in facilitating the Channel passage, and prophesied that the improvement of Boulogne Harbour would before long be an accomplished fact. The visitors then returned to London by water, reaching the Speaker's Stairs at 5 o'clock in the afternoon.

Marion.—On May 11 a screw steamer built to the order of Messrs. James Gray & Co., of Whitby, was launched from the shipbuilding-yard of Messrs. Joseph L. Thompson & Sons, North Sands, Sunderland. The ceremony of naming the vessel *Marion* was performed by Miss Gray, of Whitby. The steamer is of the following dimensions, viz.:—Length, 278 ft.; breadth, 35 ft.; depth of hold 24 ft.; and of 2,800 tons burthen; built under special survey, on the three-deck principle, to class 100 A at Lloyd's. This vessel has a full poop, long bridge house, and full topgallant forecastle; the main and bridge decks are of iron. The engines, which are on the compound surface-condensing principle, are being fitted by Mr. John Dickinson, of Palmer-hill Engine Works, Sunderland. The *Marion* will be schooner-rigged, the lower masts being of iron. Four horizontal steam winches will be fitted, also patent windlass and patent steam steering gear, and other modern improvements for securing economy and despatch. She is intended for the American and Indian trades, and is an addition to the fleet of steamers owned by Messrs. James Gray & Co., of Whitby.

Tangier.—On the 11th May there was launched from the shipbuilding-yard of Messrs. Raylton, Dixon, & Co., Middlesbrough, an iron steamship named the *Tangier*, which has been built to the order of Messrs. Angier Brothers, of London, and is especially intended for the American trade. Her dimensions are:—278 ft. long, by 35 ft. 3 in. beam, by 24 ft. 6 in. depth of hold. She has iron maindeck, wooden sheathed upper deck, and a third tier of beams, water ballast in after hold, and under engine-room and in large chamber in fore hold. Her carrying capacity will be about 2,800 tons, and she will be fitted with engines of 170-horse power by Messrs. Thomas Richardson & Sons, of Hartlepool. On leaving the ways she was christened by Miss Gillan, of Ayr (N.B.).

Roxburgh Castle.—On May 11 a screw steamer, built to the order of Messrs. Stephens & Mawson, of Newcastle, and destined for the American trade, was launched from the shipbuilding-yard of Messrs. Bartram, Haswell, & Co., South Dock, Sunderland. As the vessel left the ways she was christened the *Roxburgh Castle*, by Miss Storrs, daughter of Mr. William Storrs, J.P., of Stalybridge. The vessel is constructed on the three-deck principle, and is classed 100 A 1 at Lloyd's, and is of the following dimensions: Length between perpendiculars, 285 feet; breadth, 36 ft.; depth of hold, 24 ft., having iron upper deck covered with yellow pine. She has also an iron maindeck, with an extra stringer keelson running about half the length of the vessel between decks, and connected to a shell-plating by angle irons to ensure perfect strength for the trade in which she is intended. Great attention has been paid to the loading and discharging of cargo, the vessel having five cargo hatchways, and four steam winches worked on the horizontal principle, and supplied by Messrs. J. H. Wilson & Co., of Liverpool. She has also a steam steering gear of the most modern construction. The steamer is built on the cellular bottom principle, which is considered to add to her longitudinal strength. The engines and boilers are being supplied by Mr. John Dickinson, of Sunderland. The vessel will run between the Tyne and New York, and provision has been made for first-class passengers and a considerable number of steerage. She is also specially fitted for the cattle trade.

Tyrolese.—On the 24th May there was launched from the Shipbuilding-yard of Mr. Robert Thompson, jun., Southwick, Sunderland, an iron screw steamer, of 330 ft. long by 36 ft. broad, and 25 ft. 6 in. deep, and of about 3,600 tons deadweight. The vessel has been specially built for the cattle trade to the order of Messrs. John Glynn & Son, Liverpool, and is the second of the kind built by Mr. Thompson for this firm. She has been constructed under Lloyd's special survey to class 100 A 1, and the Board of Trade. Her engines, which are of 300-horse power, are on the inverted direct-acting compound surface-condensing principle by Mr. George Clark, of Southwick Engine Works. The vessel has three decks, two being laid of iron, upper deck covered with wood; also long poop, bridge and forecastle connected by means of gangways, and a roomy iron wheel and chart-house on bridge. She has four holds, carries water ballast in main and after holds, and trimming tank in the fore peak; also ample fresh water accommodation, and large condenser. A cabin is to be fitted up aft for the accommodation of passengers and Captain; the bridge-house amidships with large galley and berths for Officers, Engineers, and cattle men; and the forecastle for seamen and firemen. The vessel will be fitted with four steam winches, one of which is worked by friction, and extra large horizontal donkey boiler, patent steam steering apparatus, and patent screw gear aft, and all the most recent improvements. As the vessel left the ways she was christened the *Tyrolese* (*pro tem*), by Miss Laura Swainston, of Sunderland.

Deerhound.—On the 22nd of May there was launched from the yard of Messrs. C. Mitchell & Co., Newcastle-on-Tyne, a screw steamer, 185 by 25 by 13, classed A1 100, special survey. Has topgallant forecastle, full poop (110 feet long), with saloon; is fitted with water ballast, and every modern improvement. The engines are compound, of 75-horse-power, made by Mr. J. Clark, Newcastle. The vessel has been built to the order of Messrs. Robert Thomson & Co., London.

Julia.—On the 24th May there was launched from the Wear Dockyard, Sunderland, by Messrs. S. P. Austin & Son, an iron screw-steamer, of the following dimensions:—Length between perpendiculars, 224 feet 6 inches; breadth (extreme), 32 feet; depth of hold, 16 feet 6 inches; constructed with long half-poop, bridge-house, and topgallant forecastle; to class 100 A1 at Lloyd's. Her engines (compound surface condensing, 120-horse power), and boilers will be fitted by Mr. G. Clark, Southwick. She is fitted with a patent windlass, three steam winches, donkey boiler, double bottom for water ballast, and all the latest improvements. She has been built to the order of a Hamburg firm for the general trades. As she left the ways she was named the *Julia* by Miss Spooner, of London.

Fairy.—On the 24th of May a trawling smack, built to the order of Mr. J. W. Hame, of Lowestoft, was launched from Mr. M'Cann's shipyard, Garrison Side. As the vessel took the water she was named the *Fairy* by Miss Cuttill.

Dragut.—On the 24th May, Messrs. Scott & Co. launched from their yard at Cartsdyke, a screw steamer named *Dragut*, built to the order of the Compagnie Générale Transatlantique of Paris, and specially designed for the intermediate service of the Algerian Mail, for which that company have recently obtained the contract from the French Government. This vessel is the first of three which were ordered from Messrs. Scott & Co. on the 13th of February last, and the actual time employed in her construction, after plans were arranged and work commenced, has been less than three months. The dimensions of the vessel are—185 feet in length, 25 feet beam, 17 feet depth of hold, and she measures 550 tons. She is fitted up internally for first, second, and third class passengers. The engines are compound surface condensing, having cylinders 25 inches and 50 inches in diameter, with a stroke of 30 inches, made by the builders, the boilers being fitted with Leeds Forge Company's patent corrugated furnaces. After the launch the vessel was taken to the crane, where the machinery is being placed on board.

LAUNCHES.—SCOTCH.

Aline—On the 24th April there was launched from the shipyard of Messrs. Ramage & Ferguson, at Leith, a steam yacht of 360 tons, built to the order of W. P. Walker, Esq., of London and Brighton. From her fine lines and powerful engines a high rate of speed is expected. The ceremony of naming the vessel *Aline* was performed by Mrs. Walker, wife of the owner.

Ranee.—On the 24th April the *Ranee*, a screw steamer, built to the order of Mr. Joseph Tinn, Bristol, was launched by Messrs. Dobson & Charles, Grangemouth. Her dimensions are:—Tonnage, 350; length, 135 ft.; breadth, 22 ft.; depth, 11 ft. 3 in. Her engines, which will be 45-horse power, will be constructed by Messrs. Dunsmore & Jackson, Glasgow.

Hispania.—On the 24th April a screw steamer named the *Hispania* was launched at Partick. She is of the following dimensions:—Length, 365 ft.; breadth, 38·5 feet; depth, 28·7 ft.; and of 3,300 tons register. This vessel will form an addition to the fleet of the Anchor Line, and is intended for their Indian service. Her machinery has been made at Messrs. D. & W. Henderson & Co.'s engineering works at Finnieston Quay.

Tridente.—On the 26th April Messrs. Wm. Denny & Brothers launched from their shipbuilding-yard at Dumbarton a steel saloon paddle steamer of the following builders' dimensions, viz:—185 by 27 by 11; gross tonnage about 700 tons. She has been built for the Lloyd's Argentine de Navigacion a Vapor Company, and is intended for passenger service in South America. This company has been formed in London with the view of developing the traffic of the River Plate. The vessel, on leaving the ways was named the *Tridente* by Miss Violet Denny, of Dumbarton. The engines, which will be supplied by Messrs. Denny & Co., are of the compound surface condensing type, and of 800-horse power.

Lake Manitoba.—On the 26th April the screw steamer *Lake Manitoba* was launched by Messrs. James & George Thomson, Clyde Bank Yard, Dalmuir. She is intended as an addition to the Beaver Line, owned by the Canada Shipping Company (Limited), trading between the Mersey and Montreal and Quebec. The ceremony of christening her was performed by Mrs. Selkirk, wife of the general manager of the company. This steamer is a sister ship to the *Lake Winnipeg*, also built by Messrs. Thomson. Her dimensions are as follows:—Length, 355 ft.; breadth, 40 ft.; depth, 31 ft.; tonnage, 3,300 tons. She will be supplied with direct-acting compound vertical engines of 400-horse power nominal, and will be classed 20 years in the Liverpool red book, and 100 A1 at Lloyd's, having been built above the requirements of both specially for the Canadian trade.

Rohilla.—On 27th April, Messrs. Caird & Co., Shipbuilders, Greenock, launched from their shipbuilding-yard a screw steamer built to the order of the Peninsular and Oriental Steamship Company. The dimensions are as follows:—Length, 384 ft.; breadth, 40 ft.; and depth, 28 ft. 2 in., moulded. She is classed 100 A1 at Lloyd's, as a three-decked steam vessel, and will form an addition to the fleet already turned out for this company by the Messrs. Caird. As the steamer left the ways she was named the *Rohilla*, by Mrs. Captain Lea, wife of the commander of the newly launched P. and O. steamer *Ravenna*, built by Messrs. Denny, Dumbarton.

Ulloa.—On the 27th April, Messrs. Napier, Shanks & Bell launched from their yard at Yoker an awning-decked screw steamer of about 950 tons, a duplicate of the *Soto*, launched by the same builders about a month ago. These vessels are for the service of Messrs. R. Macandrew & Co., London, and Messrs. J. Roca & Co., Barcelona. The ceremony of naming the new ship *Ulloa* was performed by Mrs. Kennedy, wife of Thomas Kennedy, Esq., Kilmarnock. The *Ulloa's* machinery will be put on board by Messrs. Dunsmuir & Jackson, and thereafter she will load, under charge of Messrs. Wilson Bros., Glasgow, for Barcelona.

Steam Hopper.—On 27th April the second steam hopper, for the use of the Russian Government, was launched from the iron shipbuilding-yard at Blyth. She has been built under the inspection of Messrs. Burt & Pearson, of St. Petersburgh, and is 120 ft. 6 in. in length, 28 ft. in breadth, and 11 ft. in depth, and is so built that she will discharge her cargo in very shallow water. The vessel was towed round to the Tyne, in order to have her engines fixed, which are to be 150 indicated horse power.

Avlona.—On the 27th April a steamer named the *Avlona*, built by Messrs. Gourlay Brothers to the order of Mr. William Thomson, was launched at Dundee. She is 284 ft. in length, 34 ft. 6in. in breadth, and has a depth in hold of 24ft.; her nett tonnage is 1,250, and engines of 200 nominal horse power are to be fitted up. The *Avlona*, which is schooner-rigged, will have steam-steering gear and all the newest improvements. She will be employed as a general trader, and Captain Halcrow, now of the *Barcelona*, has been appointed commander.

Ville de Madrid.—On the 27th April, Messrs. A. & J. Inglis launched from their yard at Partick a screw steamer named the *Ville de Madrid*, for the Compagnie Générale Transatlantique of France. The vessel is the second which has been entrusted to Messrs. Inglis by this company, and the firm are constructing a third with great cargo-carrying capacity. Towards the close of last year the French company ordered ten superior passage steamers to be built on the Clyde, of which four were entrusted to Messrs. John Elder & Co., and to Messrs. A. & J. Inglis. The *Ville de Madrid* was named by Mrs. John Inglis, jun. The dimensions of the vessel are:—Length, 313½ ft.; breadth, 33½ ft.; depth (moulded), 25½ ft.; gross tonnage, 1875. The engines are on the compound principle, with inverted cylinders and surface condensers, the high pressure cylinder being 42 in. in diameter, with a stroke of 4 ft. The steam is supplied by two circular double-ended boilers of 13½ ft. diameter and 17 ft. long, with 12 furnaces. The boilers are constructed for a working pressure of 75 lbs. of steam per square inch, and the contract speed of the engines is 14 knots, with an indicated horse-power of 2 400. Accommodation is provided for 60 first, 40 second, and 60 third-class passengers, besides the ship's complement of 50 of a crew—all told. She will be schooner-rigged with iron masts, and for safety she will carry half-a-dozen boats, four of them lifeboats. The *Ville de Madrid* will be fitted up with all the latest appliances, including steam steering-gear, steam windlasses, winches, with hold pumps attached, fresh water condensers, centrifugal pumps, &c.

Ardoe.—On the 28th of April there was launched from the building-yard of Messrs. Hall, Russel & Co., Aberdeen, an iron screw-steamer of the following dimensions:—Length, 250 ft.; breadth, 33 ft.; depth of hold, 18 ft.; gross measurement, 1,390 tons. The vessel has been built under special survey, to class 100 A 1 at Lloyd's, and will be fitted with compound surface-condenssing engines of 140-horse power nominal, steam winches, patent windlass, water ballast, and all the most approved appliances for facilitating the loading and discharging of cargo. The steamer has been built to the order of Messrs. Adam & Co., is intended for the Baltic and Mediterranean trades, and will be under the command of Captain Mutch, late of the *Thomas Adam* (s). As the steamer left the ways she was named the *Ardoe* by Mrs. A. M. Ogston, of Ardoe. The *Ardoe* was afterwards taken to the shear poles for the purpose of receiving masts and machinery.

St. Augustin.—On the 28th of April Messrs. John Elder & Co., launched from their shipbuilding yard at Govan another steamer for the Compagnie Générale Transatlantique, being the second of the four entrusted to the Messrs. Elder. The steamer, which was named the *St. Augustine* by Miss Wyllie Guild as it left the ways, is in every way similar to the *Moise*, launched from the same yard on the 12th of April, viz.:—Length, 313½ ft.; breadth, 33½ ft.; and depth 25½ ft., with gross tonnage of 1,875, and engines to indicate 2,400-horse power. The *Moise*, which is now being completed in the tidal basin of the firm, will be ready for sea in the course of 10 days, and the *St. Augustin* and the other two vessels not yet launched must be handed over to the French company on or before the 1st of July.

Adjutant—On the 29th April there was launched from the shipbuilding-yard of Messrs. Barclay, Curle, & Co., at Whiteinch, an iron screw steamer for the Bird Line of steamships, owned by Messrs. Seater, White, & Co., Leith. The vessel is of the following dimensions:—Length, 310 ft.; breadth, 35¼ ft.; depth, 25¼ ft.; register tonnage, 2,300 tons. She will be fitted with engines of the compound surface-condensing type, having clylinders 36 and 63 ins. diameter, by 45 ins. stroke. The vessel on leaving the ways was named the *Adjutant* by Miss Girlchrist.

Redland.—On the 1st of May the Campbeltown Shipbuilding Company launched from their yard, at French Point, an iron screw steamer of 180 tons burthen, built to the order of Mark Whitwill & Sons, Bristol, owners of the Great Western Line of steamers. She will be supplied with compound surface-condensing engines by Messrs. Kincaid, Donald & Co., of Greenock. The vessel was named the *Redland* by Miss Melville, of Buchhill.

Drift.—On the 6th May there was launched from the building-yark of Mr. Thomas Sandry, of Porthleven, a yacht of the same style of build as the first-class mackerel drift-boats of the Mount's Bay. She is owned by Mr. C. Clarke, of Plymouth. She is built of oak timbers, and pitch pine planks, of the following dimensions: —Length of keel, 40½ ft.; overall, 45 ft.; depth, 8 ft. 2 in.; beam, 13ft. without, and is lug rigged. Her cabin and internal fittings are to be put in at Plymouth. She is named *Drift*, and will carry the flag of the Thames Royal Yacht Club.

Frolic.—On the 7th May, Mr. James Adam launched from his boatbuilding-yard, at Gourock, a yacht of the following dimensions: —Length, 25 ft.; breadth, 6 ft.; and depth, 5 ft. She has been built to the order of Mr. William Adam, Greenock, and will be fitted out at once by her builder. The yacht is named *Frolic.*

Malemba.—On the 8th May there was launched on the Clyde, by Messrs. John Elder and Co., a screw steamer, sister to the *Coanza*, for the British and African Steam Navigation Company, of Liverpool and Glasgow. She is classed 20 years at the Liverpool Underwriters' Registry; and she was named the *Malemba* by Mrs. Dempster, of Liverpool. Her dimensions are:—Length between perpendiculars, 290 ft.; breadth, 36 ft.; depth of hold, 18 ft. The vessel is specially designed to have large carrying capacity combined with light draught of water, and is for that reason built entirely of steel. She will thus be enabled to cross the bars which are situated at the entrance of most of the African ports, and save the necessity which at present exists of transhipping the cargo to shallow draught vessels. The engines which are being supplied by the same firm, are on their compound principle, with all the latest improvements, and will develope 950 horse-power indicated, which will give a speed of about 12 knots an hour. The vessel, although intended principally for cargo, will have good accommodation on deck for about 20 passengers, besides officers, engineers, and crew, and will be fitted with steam windlass winches, and all the latest improvements.

Garry.—On 12th May there was launched at Dundee, by W. B. Thompson, a screw steamer named the *Garry*, for Messrs. George Armitstead & Co., of that port. She is commanded by Captain Charles Taggart, late of the *Nina*, and will be engaged in the Baltic and Archangel flax trades.

Eira.—On the 12th of May a steam-yacht was launched from the building-yard of Messrs. Stephen & Forbes, Peterhead, being the first steamer that has been built at the port. The yacht has been built to the order of B. Leigh Smith, Esq., London, and is to be used for private explorations in the Arctic regions and trips to the Northern Seas. The frame of the vessel is of oak, lined outside with iron bark, and she is fitted up internally in a very strong and substantial manner. Her dimensions are—Length of keel, 125 ft.; breadth, 25 ft.; depth 12 ft.; and probable tonnage, 260 gross. She will be fitted up with compound surface-condensing engines of 50-horse power. As the vessel left the ways she was named the *Eira.*

Garnet.—On the 22nd May there was launched at Dundee an iron steamer named the *Garnet*, by Messrs. Gourlay Bros. & Co., for Mr. P. M. Duncan, of Dundee. Her dimensions are as follows:—Length, 218 ft.; breadth, 29 ft. 8 in.; depth of hold, 15 ft. 6 in.; 1,008 tons gross; 100-horse power. The vessel will be commanded by Captain William Johnson, late of the *Amethyst*, and will be employed in the Baltic and Mediterranean trades.

Ville de Barcelona—On 22nd May, Messrs. Caird & Co., shipbuilders, Greenock, launched a screw steamer, built to the order of the Compagnie Générale Transatlantique. As she left the ways she was named the *Ville de Barcelona*, by Madame Letteau, wife of M. Letteau, Inspector of the Company's steamers in Greenock. The following are the principal dimensions of the *Ville de Barcelona*:—Length, 322 ft.; length of keel and forerake, 312 ft.; length on loadwater line, 312 ft.; breadth (moulded), 33 ft. 6 in.; depth (moulded), 25 ft. 6 in; depth of hold, 24 ft. 6¼ in.; gross tonnage, about 1,850 tons. Two tugs were in attendance and towed the steamer to the Victoria Harbour, where she will be fitted out with her machinery, &c.

LAUNCH.—IRISH.

Whitehead.—On the 5th inst., an iron screw-steamer, named the *Whitehead*, was launched from the shipbuilding-yard of Messrs. Harland & Wolff, Queen's Island, Belfast. The steamer is built to the order of the Ulster Steamship Company (Limited), of which Messrs. G. Heyn & Sons, Ulster-chambers, Belfast, are the managers, and will be engaged in their Baltic and Mediterranean trades, principally in connection with the port of Belfast. The dimensions of the *Whitehead* are.—Length, 250 ft.; breadth, 31 ft. 3 in.; depth, 17 ft. 6 in.; about 1,250 tons gross, and 750 tons nett register. The vessel is expected to carry about 1,800 tons dead weight. The engines, which are to be supplied by Messrs. James, Howden & Co., of Glasgow, are on the compound surface condensing principle, with all the latest improvements. They will be about 130 nominal horse-hower, the cylinders being 28 in. and 53 in., with 3 ft. 2 in. length of stroke. Steam will be supplied from two boilers with large heating surface, and of superior construction, by the same makers. The hull is built upon the longitudinal bracket system, having a double bottom extending fore and aft, fitted for water ballast, with extra strengthening and bracketed upon every frame. The steamer, which is classed 100 A 1 at Lloyd's, will be schooner-rigged, with two iron pole masts. She has four large hatchways, and will be supplied with four powerful steam winches, and every facility for very rapid loading and discharge of cargoes. The *Whitehead* will be commanded by Captain Thomas M'Calmont, late of the *Fair Head* (s).

TRIAL TRIPS.

NEW FRENCH MAIL STEAMERS.—The *Charles-Quint*, built by Messrs. A. & J. Inglis, Pointhouse, Glasgow, the first of the new fleet of French mail steamers, was officially tested on May 22nd, and the results were highly satisfactory. Towards the end of last year the Compagnie Générale Transatlantique ordered ten steamers for their new line between Marseilles and Algiers, for which they had obtained the mail contract from the French Government. The order was distributed as follows:—Messrs. John Elder & Co., Glasgow, four vessels; Messrs. A. & J. Inglis, Glasgow, two; Messrs. Caird & Co., Greenock, two; and Mr. W. Richardson, Newcastle, two. The stipulated time for the completion of the vessels was seven and a half months, and, as many entertained doubts as to the ability of the shipbuilders of this country to turn out the fleet in so short a time, the progress of the vessels has been watched with interest. Considerable dissatisfaction was expressed in French commercial circles at so much work having been diverted from native hands, but M. Pereire, president of the Compagnie Générale Transatlantique, justified the conduct of the company in withdrawing the work from native builders by naming the short time and low prices of the English and Scotch shipbuilders as compared with the terms of their French competitors. The result shows that the directors of the company have not misplaced their confidence in the energy of our shipbuilders, as it is now pretty certain that nearly all the ten vessels comprising the fleet will be completed within the contract time. Messrs. A. & J. Inglis have launched two vessels; Messrs. John Elder & Co., two, and Mr. Richardson, two, while Messrs. Caird & Co. will launch their two vessels shortly. The *Charles-Quint*, the first vessel of the new fleet to be completed, was begun on the 25th of November last, 15 days after the date of the contract, so that less than six months has been occupied in her construction. The feat is probably unparalleled in the history of shipbuilding. The new ship was officially tested on Friday, when several full speed trials were made on the measured mile on the Firth of Clyde. The mean of six runs was 15¼ knots, and M. Daymard, who watched the trials on behalf of the Compagnie Générale Transatlantique, expressed himself as highly gratified with the result.

The Skyro (s).—This steamer, lately built by Mr. James Laing for Messrs. D. G. Pinkney & Son, both of Sunderland, went on her trial trip. In order to adjust compasses she left Sunderland early in the morning. The weather was all that could be desired. *The Skyro* steamed northwards, nearly to the Coquet Island, and with 1,500 tons of coals on board, she attained a speed of 10 knots, a satisfactory result to all concerned. Her engines worked extremely well. *The Skyro* returned about 6 o'clock, and left for Stockholm. She is commanded by Captain Scarlett, and is intended for the Baltic and Mediterranean Trades.

Trojan.—The Union Steamship Company's new Royal Mail steamer *Trojan*, built by Messrs. J. & G. Thomson, of Clyde Bank, Glasgow, underwent her trial at the measured mile in Stokes Bay. The fastest run made was at the rate of nearly 16 knots per hour, and the average of four runs gave a mean speed of 14·925 knots, which is equal to 17½ statute miles per hour. The leading dimensions of the *Trojan* are as follows:—Length, 365 ft.; breadth, 43 ft.; depth, 32 ft. She is of 3,554 tons register, and her indicated horse-power is 3,700.

The Vincenzo Florio (s).—This new mail steamer, built and engined by Messrs. Alexander Stephen & Sons, Linthouse, for Messrs. J. & V. Florio & Co., of Palermo, proceeded down the Firth of Clyde on the 22nd April for a trial of speed over the measured mile, afterwards going out as far as the Isle of Man for a more extended trial. *The Vincenzo Florio* is a screw steamer of the highest class at Lloyd's, barque rigged. Her dimensions are 340 by 38 by 30·4½ moulded, giving about 3,000 tons gross register. She is fitted with engines of 370-horse power nominal, having cylinders 48 in. and 90 in. diameter by 4 ft. stroke, the steam being supplied by two double-ended boilers with a working pressure of 75 lbs. The vessel is built with a double bottom on the cellular principle for water ballast. Accommodation is provided under the poop aft for 42 first-class passengers. Under the upper deck forward there is accommodation for 140 second-class passengers. She is fitted with all the most modern improvements for the working of the ship, and the rapid loading and discharging of cargo, having steam windlass, steam steering gear, steam cranes, steam winches, &c. At the measured mile *The Vincenzo Florio* attained a mean speed of 13·6 knots; on the extended trial of over 200 miles continuous steaming at sea, the average was 12·9 knots. These results, being very considerably in excess of those promised by the builders, gave great satisfaction to the representatives of the Owners. *The Vincenzo Florio* is to be commanded by Captain Pirandello.

Gamecock.—On the 24th April the new steel twin-screw towing steamer *Gamecock*—a sister vessel to the *Stormcock*—had its trial trip on the Mersey, and showed results in regard to speed and other matters highly satisfactory to all interested. A numerous party was on board the steamer on the invitation of her owner and designer, Mr. W. Becket Hill, and for whom she was built by Messrs. T. Brassey & Co., of the Canada Works, Birkenhead. The *Gamecock*, although sister ship to the *Stormcock*, possesses several improvements over that vessel. She is 360 tons register, built of steel manufactured specially by Messrs. Charles Cammell & Co., Sheffield, by the Siemens process. Her engines indicate 1,300-horse power, and on her trial she readily attained a speed of 15 knots, there being just sufficient breeze and sea to prove her a really good sea-boat. She has two pairs of direct-acting surface-condensing engines on the twin-screw principle, which enable her to turn in her own length. She is fitted with two of Mr. Henry Turner's patent multitubular boilers, being the second vessel which has been fitted with boilers of the same kind. Both engines and boilers worked most satisfactorily throughout the entire trip.

The Lady Tyler (s).—On the 4th May the new iron passenger steamship *Lady Tyler*, belonging to the Great Eastern Railway Company, and built by Messrs. T. & W. Smith, North Shields, left the Tyne on a trial trip. The vessel was built for the Continental passenger service between Harwich and Rotterdam. She is 200 ft. in length, 30 ft. in breadth, and 13ft. 6in. in depth. Her engines, of 350-horse power, are by Messrs. R. & W. Hawthorn, Newcastle. The principal saloon is about 40ft. in length, and accommodation is provided for above 200 first and second class passengers. On the occasion of the trial trip there was a strong swell, and the steamer behaved admirably. After running out to sea some distance, she returned to the Tyne about noon.

Rothesay.—On the 5th May the iron screw-steamer *Rothesay*, of Liverpool, built at Palmer's Yard, Jarrow, for Messrs. M'Naughton & Co., Liverpool, had her trial trip at sea. The *Rothesay* is of the following dimensions:—Length 285 ft. by 37 ft. broad, and 24½ ft. depth of hold. She is classed 100 A 1 at Lloyd's, and has a carrying capacity of over 3,000 tons dead weight. She has on the bridge Lachland's patent steam steering gear, which during the entire run worked admirably. The engines are of 220-h.p. nominal, and with a working pressure of 80lbs. to the square inch on the boilers, and 72 revolutions per minute during the trial run over the mile, an average speed of 11½ knots was obtained. After returning to the River the *Rothesay* was taken to Tyne Dock, from whence she will sail to India.

The Harley.—This new screw steamer ran her trial trip on the 5th May. After adjusting compasses in Gourock Bay she proceeded to run the measured mile, attaining an average of about 10 knots an hour. The *Harley* afterwards sailed for Ardrossan, where she will load coal for Cork. She was built by Messrs. Russell & Co. for Mr. Harley, of Cork, and will be engaged in trading between Newport and Cork, and is under the command of Captain Cremore.

The Tafna.—On the 6th May the iron screw-steamer *Tafna*, recently launched by Messrs. Schlesinger, Davis & Co., from their works at Wallsend, had her trial trip at sea. The *Tafna's* leading dimensions are:—Length, 253 ft.; breadth, 33 ft.; and depth 23½ ft.. She classes 100 A 1 at Lloyd's, and has a spar deck and raised forecastle. The whole of the deck arrangements are of the strongest kind. Two round iron lighthouses are placed forward. A main bridge is carried across the vessel amidships, together with an upper bridge, thus forming an excellent look-out. The engines, of 200-horse power, have been supplied by Messrs. R. & W. Hawthorn, of Newcastle. During the trial trip the engines worked smoothly and well without any hot bearings, and the results obtained were a mean of 10 knots per hour. The *Tafna* is under the command of Captain Dessaux.

Titania.—On 7th May, the *Titania* (s), recently built by Messrs. Raylton, Dixon, & Co., Middlesbrough, for Messrs. C. T. Bowring & Co., of Liverpool, left her builder's yard to make her trial trip, on her first voyage thence to Dundee. This vessel, which has been specially built above Lloyd's requirements for the Atlantic trade, is :—278 ft. length over all, by 35·3 beam by 24·6 depth of hold. She is built on the three-decked principle, her main and upper decks of iron, the latter being sheathed with wood; she is strongly fitted with shifting boards, dividing her holds into several compartments for grain carrying in bulk, has water ballast in engine-room and after hold, and in a large chamber in her forehold, which can at will be used as carrying space. Her gross register is about 2,000 tons, and she will carry 2,780 tons on 22 ft. draught of water. Her engines of 170-horse power, fitted with all the latest improvements, are by Messrs. Thos. Richardson & Sons, of Hartlepool; she has four steam winches; iron pole masts, and is in every way completely fitted and adapted for the Atlantic trade. A run was made off Hartlepool as a preliminary trial of her engines, which was very satisfactory, and the vessel then proceeded on her voyage to Dundee, where she will fill up before making her first voyage to New York.

The Elcano.—This vessel, just completed by Messrs. A. M'Millan & Son, Dumbarton, was down the Firth on her trial trip on May 11. On the measured mile she was tried progressively, and the speed obtained was considered by builders and owners as highly satisfactory. The *Elcano* has been built for the mail and passenger service of Messrs. Olano, Larrinaga & Co., between the islands of the Spanish Philippine dependencies, and is fitted up for a number of first-class passengers. The engines were made by Mr. David Rowan, Glasgow.

The Hexham.—On the 12th May, the new screw steamer *Hexham*, built by Messrs. A. Leslie & Co., Hebburn, to the order of Messrs James Turpie & Partners, North Shields, had her trial trip to sea. She is of the following dimensions :—Length, 260 ft., breadth, 34 ft.; depth, 23 ft. 6 in.; gross register 1,715 nett, 1,115 tons. The engines, by the North Eastern Engineering Company, Sunderland, are 180-horse power nominal. She will be commanded by Captain D. Turpie, and is intended for the East Indian, American, and general trades, for which purposes she has been fitted up in a substantial manner, and has all the latest improvements. After a very enjoyable trip the vessel was brought back to the Tyne to load in Howdon Dock for Port Said, whence she goes to the Madras coast to load for Marseilles.

Storm Queen.—On the 14th May, a trial was made with the screw-steamer *Storm Queen*, owned by Messrs. Ridley, Son & Tully, and built by the firm of C. S. Swan & Hunter, of Wallsend. The vessel is 280 ft. long, and 36 ft. beam, and a depth of hold of 26 ft. 5 in., and is fitted with water ballast tanks, all fore and aft. The engines are made by the Wallsend Shipping Company with cylinders 68 and 35 ins. diameter, with a stroke of 45 in. and worked remarkably well.

The Canton.—On the 15th May, the steamer *Canton*, built by Messrs. Wigham Richardson & Co., of the Neptune Shipbuilding and Engineering Works, Newcastle, for Captain J. C. and Mr. R. Jaques and Partners, was taken to sea for her trial trip. She has been specially fitted out for the Eastern trade, and her principal dimensions are :—Length over all, 300 ft.; breadth, 34 ft.; depth, 25 ft. She is fitted with very powerful engines, made in the Builders' own works; the cylinders are 35 and 68 inches diameter, by 45 inch stroke, and are fitted with steam starting and reversing gear, and embrace all the most recent improvements. On the trial they worked without a hitch with the most satisfactory results, driving the vessel over 12 knots with 600 tons on board, and will doubtless be good for 11 knots loaded ship at sea.

Prins Hendrik.—On 22nd May the trial trip of the *Prins Hendrik*, which was launched a few weeks ago from Messrs. Elder's yard, took place on the Clyde. The vessel is an iron paddle steamer of 1,652 tons gross register, and her dimensions are :—Length over all 300 ft.; breadth of beam, 35 ft.; depth (moulded), 24 ft. 3 in., while her engines, supplied by Messrs. Elder & Co., are 600-horse power nominal, and are constructed on the builders' compound oscillating principle, with all the newest adaptations. The steamer has been designed and constructed for the mail and passenger service of the Stoomvaart Maatschappij Zeeland, Amsterdam, to ply between Flushing and Queenborough. She is provided with all the latest improvements for the safety of the passengers and economizing the labour of the crew, and has accommodation for 150 first class and 40 second class passengers. The *Prins Hendrik* is a sister vessel to the *Prinses Marie* and *Prinses Elisabeth*, built by the same firm, and in her runs on the measured mile the *Prins Hendrik* gave evidence that in point of speed she is well entitled to take her place beside her two sister ships, which in the course of their passages have attained to 18 knots per hour. The steam steering gear, which was made for the *Prins Hendrik* by Messrs. Bow, M‘Lachlan & Co., of Paisley, worked admirably, the vessel answering every movement with remarkable promptitude.

St. Gothard.—On 22nd May the screw steamer, *St. Gothard*, built by Messrs. Readhead for Messrs. Cay, Hall, & Company, had a most successful trial trip from the Tyne. The vessel is 255ft. long, 34 ft. broad, and 23ft. in depth. She has been built under special survey, and is classed 100 A 1 at Lloyd's. She has three decks, two decks laid and the lower one of iron. Care has been paid to the stowage capacity for cargo, the vessel being fitted with permanent iron shifting boards fore and aft, and trimming hatches between decks. The masts are of iron, and the steamer is schooner-rigged. She has three steam winches, and Harefield's patent windlass. The engines, which have also been furnished by Messrs. Readhead, are of 150-horse power nominal. They are placed amidships, and the engine-room is covered in with a bridge. The vessel is intended for general trade, and will carry 2,350 tons dead weight. She will be commanded by Captain Westerberg. The steamer was taken along the measured mile, and a mean speed of 10½ knots was obtained.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

To the Editor of the MARINE ENGINEER.

SIR,—As I see in your valuable journal of this month you invite discussions on "break downs while at sea," a little account of one, which occurred with me recently may not be altogether out of place. The engines were the usual compound inverted type of 250 H P nominal, with cranks set at, I believe, 135°. Of course the names of ship and trading ports do not signify for publication. We broke down in this manner :—H P cylinder valve face broken, and the cylinder itself cracked above the face, the steam consequently having free access from steam chest to the upper passage all the time. The cause I cannot explain, only surmise. We immediately took out the H P valve, plugged up top and bottom steam ports of cylinder, disconnected the forward connecting rod at bottom end, lashing it back against the go-ahead column, intending to work with after engine alone. The usual steam carried was 65 lbs., so having reduced that to say about 25 lbs., attempted to start, having two donkeys on the condenser. The after engine had a lot of lead, I believe as much as $\frac{3}{8}$ in. on the bottom, and we could not get her to start. We placed the crank in the most favourable position time after time, but on taking the turning gear out she would fall down to nearly the bottom centre. With the assistance of an auxiliary valve we could get her close up to the top centre but "not over." Many trials were made but she would not start. A similar break down having come under my notice before, where the cranks were at right angles and much larger engines, I resorted to a dodge which proved successful in that case, but not in the present one; slacking the escape valve right back on top of the tow press cylinder, giving the engine a chance to free herself on top until she got a start. Well, to cut the yarn short, we did not get her to start until we were taken in tow and going at the rate of 6 knots per hour, when she started up without much trouble but after many trials. She worked well for over 300 miles to the nearest port, and the wire hawser parting about an hour after she started, we managed all right, maintaining a good vacuum of 28 knots. It is unnecessary to remark we did not trouble to allow the towing steamer to get hold of us again.

The engines usually run about 55 revs. to 58, and the single engine managed 44, with, of course, a little increase in consumption of fuel.

Now, we had common jet and discharge fitted, and when we were taken in tow were about to get the discharge valve open, &c., but not anticipating so much trouble in starting this was left to the last.

No doubt this breakdown will be much talked about when published, but it may give rise to useful discussion, and I hope to see some opinions expressed in your very interesting and useful journal. I enclose my address, and remain

Yours very truly,
May 10th, 1880. A YOUNG SECOND.

BREAK DOWNS WHILE AT SEA.

To the Editor of the MARINE ENGINEER.

SIR,—Referring to your correspondent "An Inexperienced Third's" suggestion, I have pleasure in relating the particulars of a breakdown which I assisted at repairing. While the A—— of L—— was on a voyage to the Cape of Good Hope with mails and passengers, and when to the southward of the Cape Verde Islands, one of the cylinder covers gave way. On examination we found that a crack had appeared in the upper part of the cover, which allowed the passage of steam through it, and allowed the two edges partly to separate when exposed to steam pressure. We took the cover off and patched it over with sheet iron, secured to it by tap-bolts. We had no means of countersinking the heads, so we allowed for the necessary clearance for the piston by making a wrought iron distance piece, equal in thickness to the boltheads, which we jointed between the cylinder flange and the cover. We next shored the cover down from the beams above, and by reducing the pressure of steam and working in full gear we succeeded in completing the voyage, although, of course, at an increased rate of consumption. The entire repairs lasted five days. I have heard of a somewhat similar case being completed in a much shorter time, but I do not think we lost much time over it, especially considering that such a large number of tapbolts as we required had to be made and screwed into the cover, and that we had only the ordinary sea-going tools for the job.

Yours truly,
May 6th, 1880. PROPELLER.

STEEL WIRE HAWSERS.

To the Editor of the MARINE ENGINEER.

SIR,—We are happy to inform you that, after full consideration of our application to the "cautious guardian of the Shipping Interest, viz., Lloyd's Register of British and Foreign Shipping, "to sanction the use of our patent flexible steel wire hawsers, with our appliances, in lieu of chain cables for ships classed in the book," they have granted our request by allowing one flexible steel wire cable in steam vessels in the place of one of the chain cables, subject to the size and tests of the steel wire cable and appliances being submitted and approved of by Lloyd's Committee.

We are, Sir, very pleased to be able to record this advance, for without the sanction of this powerful Committee we could not expect their rapid introduction into the Merchant Service in lieu of chain cables. The Committee of Lloyd's Register will certainly not be accused of want of caution in granting this request, when a vessel of 1,500 tons has for the last six years been using one of our steel wire cables in place of chain cables, and still has it in use in excellent condition.

It is the Lords Commissioners of the Admiralty that we have to thank for having first seen the advantages of our patent steel hawsers, and six years ago adopting their use in the Navy in lieu of chain cables on board her Majesty's ship *Valorous*, and since that in her Majesty's ship *Eclipse*, and now we have completed all our appliances for successfully working them on board ship; we have little doubt that in the course of a few years it will be as rare to see a heavy, cumbersome, unreliable chain cable on board a ship as it is now to see a heavy hemp rope cable. We must advance with the age, and at present there appears no limit to the size that ships may be built; but there certainly is a limit to size and strength of chain cable that can be made and used, and the largest ships registered at Lloyd's are only provided with a 2 5-16-inch chain cable, being 280 lbs. per fathom, having a proof strain of 96¼ tons, and a breaking strain of 134¾ tons. It is contrary to all common sense to suppose that this unreliable chain cable of 134¾ tons breaking strain, its strength depending upon the perfect workmanship of each link, one foot long, will ensure the perfect safety of a ship of 5,000 tons when riding by it in a gale of wind, but still such is the largest size and strength of chain cable they can use in ships now afloat double that size. In lifting heavy weights on shore, engineers would be thought running an undue risk if they worked ropes and appliances above one-sixth of their breaking strain, but it would appear that a sailor is supposed to make his gear do six times the work it should be called upon to do.

We can with our present machinery make our steel wire cables perfectly uniform up to the strength of 500 tons, and not half the weight of the chain cable with a breaking strain of 134¾ tons, although the Committee of Lloyd's Register at present sanction but one steel wire cable to work with one chain cable. We are happy to say we are fitting a large foreign steamer to work our steel wire cables and appliances on both sides in lieu of chain cables, and this determination has been arrived at after several years' experience of the great advantages and reliability of our patent steel wire hawsers.

We feel quite sure it will not be long before the Committee of Lloyd's Register will see that, if one steel wire cable will ride a large steamer for six years, two may be used with the greatest safety, and that it will be far safer to ride a vessel with two steel wire cables than with one steel wire cable and one chain cable.

Yours, &c.,
BULLIVANT & Co.

THE DIVER FLEUSS.—Mr. Fleuss made his first appearance at the Royal Aquarium, Westminster, lately in the large tank built for the whale and used by the seals. His remarkable performance under water was better seen than it has been elsewhere either during the few months of the exhibition of his apparatus at the Polytechnic or at Brighton. He can stay under water for five hours without an air tube or any other communication with the surface; and this absence of incumbrance gives him much greater freedom than other divers possess. The only connection between himself and the surface is a single cord. The principle of the invention consists in purifying the exhaled breath by means of caustic alkali, and revivifying it again with oxygen. In this way the diver breathes the same air over and over again, *minus* carbonic acid and *plus* fresh oxygen at every inspiration. The means by which this is effected consist, in the first place, of a small leather shield, fitted with inlet and outlet valves and shaped to the contour of the wearer's nose and mouth, over which it is held in position by elastic bands. Over this comes the helmet, which consists of an inner and outer casing, the space between forming the reservoir for the oxygen, which is there stored under considerable pressure. The remainder of the apparatus consists of a couple of purifiers, which are slung one at the back and one in front of the diver, being carried beneath the dress. In operation the exhaled breath passes from the outlet valve in the shield through a flexible tube attached to it and communicating with the front purifier. This consists of a flat metallic chamber, having an inner perforated false bottom, and being divided vertically from the top to the false bottom into two compartments. Each of these compartments contains a mass of india-rubber sponge, saturated with a solution of caustic alkali. The exhaled breath enters at the top of one compartment, passes down it, through the false bottom, and up the second compartment. It then passes through a tube to the purifier at the back of the diver, which is constructed similarly to the front one. By the time it has passed through this second purifier the air has been deprived of all its deleterious absorptions; but to fit it for respiration it must be revivified. To this end it enters the interior of the helmet and surrounds the diver's head, where it meets and admixes with a supply of pure oxygen, which is admitted from the store in small quantities by the diver as he requires it. The oxygen is stored in the helmet under an initial pressure of about 200 lb. per square inch, and its admission into the air space is regulated by means of a small valve worked from the outside of the helmet. The storage space in the helmet is sufficient to contain four cubic feet of oxygen, which supply will last four hours, that being the longest time a diver would be required to remain under water in ordinary practice. The purifiers are likewise so proportioned and charged as to remain active for a similar period. The invention will, no doubt, be found very useful in the numerous cases, which are of daily occurrence, especially in connection with docks and similar works, where the services of a diver are required only occasionally but then quickly, when it would prove of considerable advantage to be relieved from the presence of the ordinary diving paraphernalia and the necessary attendants. Mr. Fleuss is a young and vigorous man, who has served in the steamboats of the Peninsular and Oriental Company. We should mention that Messrs. Siebe, Gorman, & Co., of the Neptune Works, Westminster Bridge Road, are the manufacturers of Fleuss's helmet and gear.

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Dick, Roberts	2 C	N Shields
Gibson, David	2 C	do.
Ferguson, Robt. R.	2 C	do.
O'Dowd, Frank	1 C	do.
Hunt, George	2 C	London.
Rugeroni, A. E.	2 C	do.
Horn, Geo. M.	1 C	do.
Wallace, Wm.	1 C	do.
Jones, Wm.	1 C	do.
Edmond, Wm.	2 C	Lvrpool.
Veall, Richard	2 C	do.
Nicholas, Pan. P.	2 C	do.
Hall, Stephen E.	2 C	do.
Paul, Gilbert	2 C	do.
Webster, Geo.	1 C	Hull.
Stocks, Andrew	2 C	Glasgow.
M'Farlane, Jos.	2 C	do.
Pairman, John	2 C	do.
White, Matthew	2 C	do.
M'Pherson, Alex.	2 C	do.
Kirkwood, Jas.	1 C	do.
M'Pherson, Jas.	1 C	do.
Taylor John	1 C	do.
Waldie, William	1 C	do.
Scott, Wm. P.	2 C	London.
Fraser, G. C. H.	2 C	do.
Paterson, John	2 C	do.
Smith, Alex. C.	2 C	do.
Grassick, Jas.	1 C	do.
Swan, John A.	1 C	do.
Hepburn, Wm.	1 C	do.
M'Dowall, D. W.	1 C	Lvrpool.
Harrow, Thos.	2 C	Leith.
Skinner, Thos.	2 C	do.
Aitchison, J. B.	2 C	do.
Taylor, Charles	2 C	do.
Bisset, George	2 C	London.
Tredinnick, T.	2 C	do.
Watt, James	1 C	do.
Dance, Chrls. M.	1 C	do.
Stallard, A. C.	1 C	do.
Evans, William	1 C	do.
Jones, Hugh	2 C	Dublin.
Cound, Thomas	2 C	London.
Gibbs, Alfred W.	2 C	do.
Wise, Walter	2 C	do.
Rusden, Wm. H.	1 C	do.
Piers, Thomas	2 C	Lvrpool.
Hay, Arthur C.	1 C	do.
James, William	2 C	NShlds.
Gooding, John	2 C	do.
Wright, Thos. W.	2 C	do.
Gibson, C. F.	1 C	do.
Greener, Jno. Jas.	1 C	do.
Stanley, George	2 C	Lvrpool.
M'Nee, John	1 C	do.
Merrick, Hy. R.	2 C	Cork.
Rendall, Jas.	2 C	Aberdn.
M'Donald, Alx.	2 C	Dundee.
Walker, Andw.	2 C	do.
Dix, Henry	2 C	S'hmtn.
Jacklin, George	2 C	Hull.
Shores, Thos.	1 C	do.
Dunn, Walker	2 C	London.
Farnan, Ed. G.	2 C	do.
Jones, Rchd. M.	2 C	do.
Skelton, Harry	1 C	do.
Waterson, Jas.	1 C	Glasgow.
Breingan, Alex.	1 C	do.
Sunney James	1 C	do.
Constantine, E. G	2 C	Lvrpool.
Aikman, J. M.	2 C	do.
Phillipeos, Peter	2 C	do.
Innes, Charlton	1 C	Sndrlnd.
D'Alton, P. W.	1 C	do.
Thomas L. J.	2 C	Lvrpool.
Wilson, Stphn.	2 C	Cork.
M'Donald, F.	2 C	N Shlds.
Dick, William	2 C	do.
Angles, Thos.	2 C	do.
Bond, Samuel	1 C	do.
Williams, John	1 C	Lvrpool.
Dutton, William	1 C	London.
Moody, T. V.	2 C	N Shlds.
Wright, Thos.	2 C	do.
Jobling, Jsph. C.	2 C	do.
Bendall Wm. J.	2 C	do.
Baxter, David	1 C	do.
Rickson, Ralph	1 C	do.
Carver Dvd. M.	1 C	do.
Thompson, T. J.	1 C	do.
Laidman, Thomas	1 C	do.
Parry, Owen H.	2 C	Lvrpool.
M'Creath, Wm	1 C	do.
Waldron, Pat. L.	1 C	N Shlds.
Holbrook, Thos.	1 C	do.
Miller, Boyd	2 C	Grnock
Fisher, R. S.	2 C	do.
Niven J. J.	2 C	do.
Mackay, Adam	2 C	do.
Marshall, James	2 C	do.
Rugvie Alex.	2 C	do.
Fox, Thomas J.	2 C	do.
Brash, David	1 C	do.
Costley, James	1 C	do.
M'Kenzie, James	1 C	do.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 20th April to 17th May, 1880.

Prepared especially for THE MARINE ENGINEER *by Fell and Wilding, City Patent Office,* 23, *Rood Lane, Fenchurch St., London, E.C.*

1633 C. Pieper (communicated by A. Knaudt). Furnaces.
1641 B. Tower. Indicating speed and direction of rotation.
1660 W. L. Rutton (communicated by W. S. Smyth). Constructing subaqueous works and blocks therefor.
1674 R. L. Barker. Metallic piston packing.
1686 W. F. Batho. Dredgers and excavators.
1699 W. T. Clark. Governors of marine and other engines.
1706 N. D. Spartali. Arrangement of cranks for transmitting motion to or controlling the action of the shafts of marine and other engines and axles and shafts generally.
1715 J. H. Johnson (communicated by A. M. Jouet Pastré). Valves and valve gear.
1726 A. M. Clark (communicated by T. O. L. Schrader). Ships berths.
1728. F. E. Todd. Collapsing hand carriage for light boats.
1729 H. B. Young. Marine steam engines for driving screw and other propellers.
1740 P. Samson. Rivetted joints of boilers, &c.
1746 A. Dervaux. Purifying apparatus for steam boilers.
1749 A. M. Clarke. Preventing explosion of steam boilers.
1755 H. P. Scott and T. D. Donaldson. Anti-fouling and preservative composition for coating ships bottoms and other submerged surfaces.
1779 W. Gray. Steamships, and construction and arrangement of the boilers.
1783 A. W. Hay. Machinery for raising, lowering, storing casks, &c.
1811 G. Allix. Self-filling and discharging skeps, for grain, mud, &c.
1815 D. Jones. Steam boiler furnaces.
1825 W. Richardson. Apparatus for lowering, disconnecting, picking up, and raising ships' boats.
1829 W. R. Lake (communicated by J. Gibbons and J. de H. Harrison). Floating mattresses, life preservers, buoys, &c., and in boats, ship compartments, &c.
1861 L. H. Gullachsen and W. Brydon. Construction and fitting of ships to carry grain and other bulk cargoes.
1862 F. Travis. Ventilation of ships.
1871 R. Duncan. Compound steam engines.
1873 R. H. Tweddell. Rivetting ships and plated structures.
1879 W. Bailey. Storm deep sea floating anchors.
1884 J. A. and J. Hopkinson. Steam purifying apparatus to prevent priming.
1914 R. Punshon. Raising submerged ships.
1934 H. J. Thatcher. Instruments for adjusting and correcting deviations in the mariner's compass.
1947 J. Kosztovits. Regulating speed of engines, and propellers of screw steamers.
1974 J. H. Thomas. Screw propellers.
1987 E. A. Bourry. Steam boilers and joints.
1990 G. Pfannkuche, senior and junior. Propulsion and steering of vessels, applicable to other purposes.

RAISING SUNKEN OBJECTS.—A change in the well-known method of raising sunken objects by means of balloons has been proposed by Herr Raydt, of Hanover, in that he uses gas condensed in vessels to a liquid state, and lets it expand into the balloon under water. Carbonic acid is recommended as the most suitable gas. The balloon is made of strong canvas, saturated with caoutchouc solution, and lined thickly with caoutchouc. Above and below it has metallic plates, to which an envelope of network is connected. The plates are connected in the direction of the balloon's vertical axis by a metallic pipe having numerous apertures for admission of gas from the reservoir, which is of thick zinced iron, and is attached by screwing its entrance-pipe to the pipe projecting from the lower plate, both of which pipes are furnished with cocks. When a sunken vessel has to be raised the balloon is let down in a collapsed state, with attached reservoir; the diver admits only a little gas at first, so that the balloon may support itself, then he fastens the balloon to chains passing round the vessel. The communication between reservoir and balloon is then fully opened, so that the latter is inflated and exerts lifting force. A balloon three metres in diameter has in sea water at 10° cent. a lifting force of 116,464 kilogrammes. The cold developed by the expanding gas has little or no prejudicial effect; at most it freezes a portion of the gas, and renders the inflation somewhat slower. As with the rise of the balloon the external pressure gradually diminishes, automatic air-valves are provided in the lower plate to allow escape of gas when its pressure is apt to become excessive. Such balloons may be attached pair-wise to chains passing round a ship. Another useful application of the principle is that of giving divers a ready means of coming up to the surface; two collapsed balloons are carried on the back, and a supply of liquified gas on the breast. In the moment of danger the diver releases the balloons, and lets the gas enter them. Ammonia gas is recommended for this rather than carbonic acid, which might be liable to explode through becoming heated—a vessel of two litres capacity would suffice. The practicability of Herr Raydt's method was lately demonstrated at Kiel, when, before numerous spectators an anchor-stone weighing 306 cwt. was raised from a depth of 10 metres by means of a balloon three metres in diameter.

ROBERT WALKER'S PATENT HYDRO-CARBON FURNACE AND APPARATUS

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals, &c.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel, burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; the equivalent in Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in the case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no sparks or burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c., and economy in voyage.
8.—Cleanliness, and easier and quicker voyages.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, &c., without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

The Inventors' Record.—"Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S., (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with the coal."

The Railway Record states, "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers."

The Marine-Engineer.—"For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage."

Industry.—"At a trifling cost an enormous degree of heat was easily attained, estimated at 5000 degrees by which iron was easily melted in ten minutes, instead of taking in ordinary circumstances two hours, and glass in two hours instead of sixteen."

Iron.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The European Mail.—"These advantages are immense, and must eventually effect a complete revolution in our present mode of steam generation."

For prices, &c., and for terms for working this patent under royalties or licences or otherwise, apply to the patentee, Mr. R. Walker, 19, Buckingham-street, Strand, W.C.

NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

The Marine Engineer,

LONDON, JULY 1, 1880.

EDITORIAL NOTES.

THE Victoria Docks have been a scene of great excitement during the past week. The new extension was formally opened, on the 24th ult., by the Duke and Duchess of Connaught, accompanied by a large and illustrious circle of friends. The extension is to be called the Royal Albert Dock, whilst the old dock still rejoices in the name of the Victoria Dock. There is no doubt that the opening of this new extension will add very largely to the accommodation of the enormous liners that are now becoming all the fashion. Several very dangerous reaches of the river will have been avoided by the use of the new entrance, and the quay space will be much more ample than in the crowded Victoria Dock, so as to facilitate prompt loading and unloading. The water is now fully admitted to the new docks, so that the two together form a magnificent area of 175 acres of water in a string of docks nearly 2¾ miles long. Already all the north side, and from a quarter to half the space on the south side has been let, so this new extension promises to be one of the most busy of the docks. The total cost of this extension has been about a million and a quarter. It is to be hoped that this magnificent addition to our dock accommodation will materially aid in developing our London shipping traffic, to be equal to that of Liverpool. Messrs. Lucas & Aird were the contractors for this great work, and right well they seem to have accomplished it. They were present at the opening, with an immense number of invited friends; making a concourse of some 4,000 people, who all sat down to a handsome luncheon.

EXCESSIVE heat is one of the most uncomfortable sensations that can be encountered on board ship, either by passengers or crew. There is no doubt that very much of the oppressive heat encountered in the Red Sea and in tropical latitudes might be very much mitigated and rendered much more bearable if simple expedients were employed to relieve and reduce the temperature. In the first place the excessive and oppressive sensation of heat is only felt to a great extent when there is a large quantity of moisture in the atmosphere. This is liable to be the case where many people congregate together in close saloons or cabins, or where lights, such as lamps or candles are burning, which in addition to their heat-giving properties, also produce a very considerable amount of moisture. Now it is a property of compressed air to cause its heat to become sensible or appreciable, so that it may easily be absorbed and removed by a stream of water. The result is, that when the compressed air, cooled down to a normal temperature, is allowed to expand, it becomes icy cold, and of course may be quite dry. It seems to us that, as there is so much engine power on board a steamer, it would neither be expensive nor difficult to run an air-compressing machine which should produce a large quantity of cooled compressed air. This compressed air might then be carried throughout the saloons and state-rooms in small perforated pipes around the cornices, so as to inject a constant supply of fresh dry cold air, which would materially benefit the atmosphere.

THE battle between armour and shot is still being fiercely waged. At one time the armour seems to have reached a strength and massiveness that no shot can penetrate, but, straightway, a new gun is brought out which is capable of piercing all that has ever been constructed in the way of armour. As our ships are now about as heavily loaded as it is possible that they could be with armour, our Chief Constructor must be in somewhat of a dilemma which way to turn for further defensive arrangements against the impact of heavy shot. There are but two alternatives before him: either to further strip the parts which are not of the greatest importance, for the benefit of the vital parts, such as the battery, the engines and boilers, or to endeavour to find an improved material, with no increase of weight, which shall give a greater resistance to the shot, or to endeavour to apply a construction which in itself shall be more efficacious in the resisting of shot than the perpendicular resistance of iron plates. Under the first head, we are already applying to the *Inflexible* the new compound armour, steel faced on a wrought iron backing, which Messrs. Cammell & Co. have produced after so much trouble and experiment, and which is found to have fully 50 per cent. better resisting qualities than plain iron or plain steel plates. We think, however, that far too little attention has been paid to the possibility of constructing ironclads on the compartment system, filled with material infinitely lighter than iron, but which would quite as effectually destroy the momentum of the shot. It is a mistake, in our opinion, to imagine that the best resistance is offered by the heaviest material. Far otherwise. We know that a handkerchief is as difficult to divide by the blow of a sword as a leaden bar, and also that earth and sand forms one of the finest materials possible for breast works to resist the impact of shot. We think it quite possible that an excellent bulwark of more or less elastic or yielding material might be carried between two shells as a protection against shot, and that weight for weight, such a species of protecting armour would be more effective than the present system of iron plates.

Is the present period to see a great change in the method of water propulsion? The signs of the times almost seems to point to this. We illustrate elsewhere a startling suggestion as to Ocean Palace steamers, which should be capable of an average speed of 27 to 30 knots an hour. To effect this speed, the inventor has gone back to first principles, by advocating the adoption of modified paddle wheels. The modification consists of passing a band round two enormous drums, and fixing floats or paddles to this band at suitable intervals, so that a whole string of 21 paddles are dragged through the water at the same time. There is no doubt that there is much left to be desired in the form of both paddle wheels and screw propellers of the present day. The paddle wheels only operate by the surface of one or two paddles at the same time, and consequently waste much of their effort in churning the water and pushing it aside, as it is such a mobile fluid. The propeller again is essentially faulty, in that it always tends to throw a column of water radially outwards as well as astern, and thus wastes much of its effort in unproductive work. Many efforts are now being made to improve the means of propulsion; an endless variety of screw propellers are being constantly brought forward and thrust under the notice of ship owners and others, likely to advance its interests. The direct driving by a combined steam and water jet has been unsuccessfully applied, but probably the want of success may be due to the inefficiency of first experiments which might be removed by after investigations and improvements. There is so much general discussion and effort at improvements in this direction at present, that we fancy something will come of it ere long, and that we shall see some startling modifications in steam propulsion.

A VERY clever suggestion has lately been made for facilitating the rapid and cheap transit of coals to the Metropolis. It is very justly stated that one of the principal costs of freightage is the detention that steamers have to undergo in docking, very often enhanced by difficulties of tide and the dock dues that have to be paid for such accommodation. It is suggested that steamers might come and load under the precipitous cliffs of Boston Deeps, where there would also be water to load in any condition of tide. A whipping hoist could easily be erected on the summit of the cliffs so as to load direct into the holds of the steamers. These facilities of loading, no dock dues, and no detention would, it is suggested, so materially reduce the cost of freight, that it would save some 5/- to 6/- a ton in the delivery to London.

THROUGH pressure in our correspondence columns, we were obliged to omit the letter of Lieut. Chas. George Brooke-Hunt in our last issue. We there directed particular attention to the very praiseworthy efforts of Lieut. Brooke-Hunt to raise sufficient funds for a memorial to one of the most gallant episodes in our Navy, viz.: the wreck of Her Majesty's ship *Orpheus*. We have inserted the letter in question in this issue, in which full details of this tragic but heroic occurrence will be found, and we trust that those who may be interested in the event will give substantial aid to Lieut. Brooke-Hunt.

WE are much afraid that trade is not yet substantially revived. There has been considerable talk about the great increase of exports in the month of May and preceding months. It will, however, be found that the increased imports of America in iron and steel rails more than amount to the alleged increase of exports from England. As it is well known that nearly all the iron and steel imported by America went into stock there on speculation for the rise, and has been the ruin of most of the importers, it is evident that the increase of trade was not healthy, but a gross exaggeration of a slightly improved demand from America, owing, no doubt, to her excellent harvests last year. As the existing iron and steel furnaces and plant now ready for use in America are able to produce considerably more than all her needs, we cannot see that much dependence can be placed on any American market for our iron in the future. The Duke of Connaught anticipated cheery things for the improvement of trade, from the fact that such business men as the directors of the Victoria Docks saw fit to enter into such extensive improvements of their docks at such a time. We must all do the same, though "hope deferred" is making "many hearts sick" we are afraid.

MESSRS. R. NAPIER & SONS, shipbuilders, Glasgow, have been entrusted by the Admiralty with the construction of the hulls and machinery of the three fast steam cruisers of the *Iris* type about to be added to the Navy. The vessels, which will be named respectively the *Leander*, *Phæton*, and *Arethusa*, are to be built of steel, and are designed to attain a high rate of speed. The displacement will be about 3,750 tons, with very large coal capacity. The engines will be of horizontal compound type, working twin screws and capable of indicating 5,000 horse power. The contract will extend over a period of two years.

STEEL IN THE SHIPBUILDING YARD.

By WILLIAM DENNY, Esq., Member of Council.

[Read at the Twenty-first Session of the Institution of Naval Architects, 19th March, 1880.]

I PURPOSE, in the following Paper, to state as shortly as possible some of the experience my firm have had in the use of mild steel during the last two years.

We first used steel during the blockade-running period, and introduced it into some portions of paddle steamers we built for blockade-running purposes. The material as then made was far from satisfactory, and its behaviour did not encourage us to extend its use.

In 1876 we made our first acquaintance with the mild steel now in use, when we built for the Irrawaddy Flotilla Company a light-draught paddle steamer called the *Taeping*. All the skin and stringer plates of this vessel were of Bessemer steel, the rivets being of iron. We had perfect satisfaction in the working of this material, and the steamer after being put together in Rangoon fully evidenced the value of steel for vessels of her type. On one of her earliest trips she struck on a snag in the Upper Irrawaddy, but came off safe and sound, her plating heavily indented but unbroken. We were informed by the Superintendent Engineer of the Company he was of opinion that if she had been of iron she would have gone down under the circumstances.

Since the building of the *Taeping* we have gone largely into the use of steel, and at present have little else in our yard. This Paper covers the period following our building the *Taeping*, and the steel now referred to is entirely of the Siemens-Martin description. We did not select this kind of steel or specify it, but fell into the use of it from the fact that it was most frequently offered us, and that most of the steel works employed in producing shipbuilding material work upon this principle. All the sea-going steamers we have launched till now *have been* built of steel produced by the Steel Company of Scotland, while the steel for the light-draught steamers was made by the Steel Company, the Landore Company, and the Butterley Company.

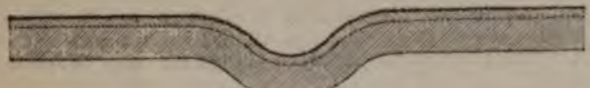
Of the steel supplied to us we have had very little reason to complain, indeed our only real ground of complaint has been the uncertainty of its delivery—a fault arising probably from the newness of the works, but none the less vexatious and serious. Unless the various steel works improve in this particular they will seriously damage their own prospects, and a word of warning upon the point may not be amiss to them. In our latest contracts we have returned to iron for no other reason than our dread of seeing our yard disorganized through the bad deliveries of material. The method of testing, adopted by Lloyd's has also greatly aggravated the effects of the bad deliveries, and will be referred to further on.

Regarding the behaviour of the steel in working, I cannot do better than quote from a letter we addressed to Mr. Waymouth on the 28th of last month, in reply to an inquiry made by him on behalf of Lloyd's Committee, for information upon this subject. In this my firm said :—

"With reference to failures in manipulation, we have very few cases to report, although we have kept a note of them. We divide these failures into failures of plates and failures of bars. The first failures of plates we noticed were in the case of four of the flanged plates forming the bilge-keels of No. 224. These four plates, after they were screwed up, developed small cracks through some of the rivet holes, piercing the flanges attaching the plates to the ship's bilge. We discovered that these cracks were due to our workmen having finished the plates at a black heat. We removed them, cut out the defective portions, welded in fresh pieces, annealed the plates as a whole and replaced them. In No. 226, which had a plate keel, the aftermost length, which was bent to the form of the keel of the stern frame, developed a small split in the extreme end. The length of the plate permitted the split portion to be cut off. The plate otherwise was found perfectly good, and was used in the steamer. One of the flat keel plates of this steamer, after being finished, was heated to a cherry red and laid down for cooling; while cooling, it bent up in the middle, and was hammered down from the top side. On being examined, a fracture was found on the under side about 6 ft. from the end, and the plate was rejected. These are all the failures we have to report in our working of steel plates, and without exception they can, as you will notice, be readily traced to the working of the material at a black heat.

"This is the really unsafe thing to do with steel, and our foremen and men have now received instructions that it is not to be attempted, and that if a piece cannot be finished at a red heat it must be completely reheated or finished cold.

"In bars we have to report no failures in the working of either the ordinary bulbs or Butterley sections, and the welded knees on the beams have in no case shown any defect, which they might have been expected to do, if at all, in being rivetted to the frames. In angles we have had one boss frame which cracked on the deep flange at the outermost portion of the boss shape. This was evidently due to the workmen laying this flange down at a black heat. In our light-draught work, where we have short pieces of angle shaped thus—



to form doubling pieces over the limber holes—we have had one or two cases of the outer edge of the flange tearing slightly while being cressed at a red heat, but no case of breaking.

"We think that, considering the failures above noted are all that we have to report out of a consumption of about 7,000 tons of steel, they are very far from being of serious moment. We can point to no similar experience in the use of iron; indeed, in a small steamer we have now building of that material, we have had to reject for failure under manipulation more plates than the total number of failures now reported to you. We may remark that the 6 ft. X 3 ft. frames, which we are working in steel for Nos. 237, 238, and 239, have not as yet produced a single failure or crack. Iron frames of similar dimensions in a steamer we built some years ago, manufactured by one of the best Scotch makers, gave us a very considerable amount of trouble from cracking on the inner edge of the deep flange in riveting them round the bilge. We believe, if a careful record were kept of the behaviour of ordinary shipbuilding iron under manipulation as compared with the behaviour of steel under manipulation, many people would be surprised to find the tables completely turned in the matter of unreliability, and that enormously to the disadvantage of iron. We had the pleasure of bringing under your notice some time ago a good illustration of this, in the behaviour of the pieces of our light draught steamers under shipment, comparing those built of iron with those built of steel."

The letter referred to in the last part of the foregoing quotation described the behaviour under shipment of the pieces of light-draught steamers built of steel, as compared with that of pieces of similar steamers built of iron. We had before 1878 built a considerable number of these vessels in iron. They were put together in the yard, and then shipped to Glasgow in lighters, from which they were transhipped on board steamers going to the East. During this shipment and transhipment we were invariably annoyed more or less by corners of plates coming off, angle irons cracking, floors breaking, and such little mishaps. Last year we built and shipped six steel paddle steamers of various sizes, varying from 250 feet to 80 feet long, without losing anything by breakages. These vessels were entirely of steel and steel riveted, and I think that, as a rough practical test, nothing can more effectively prove the general reliability of steel as compared with the unreliability of iron than this. Indeed our whole experience leads us to reverse the ideas largely held regarding steel and iron, and to look with confidence on the steel, and doubt on the iron. Our foremen and workmen hold this view of the matter very strongly, and speak most contemptuously of going back to iron. Their confidence in the power of steel to do everything and stand everything excepting working at a black heat, is of the firmest nature, and it will be acknowledged such confidence cannot be causeless.

In addition to the regular testing carried out for us by Lloyd's, and also for the light-draught work we generally have in hand, we have made some experimental tests, a few of which I wish to bring under your notice, and in doing so I must acknowledge the very considerable assistance and valuable advice afforded us by Mr. William John, also the readiness with which Mr. Mumford, our local Lloyd's Surveyor, entered into these experiments, and the desire shown by him to take interest and give assistance in all test experiments, even over and above his regular duties.

Among the earliest experiments made by us was a series of tests intended to find out whether rapidity in breaking the pieces under tensile strain affected their results disadvantageously. The enquiry was forced upon us by objections taken to rapid testing, and its results very much surprised us. They are shown in Tables I. and II. The time was taken by a chronograph started whenever the lever of the testing machine floated and stopped when the piece

TABLE I.—TIME TESTS.

Result of Experiments on Twelve similar Specimens cut from the same HARD STEEL *Plate, to ascertain the Effects of applying the Load quickly and gradually.*

POSITION OF SAMPLES IN PLATE.

1	2	3	4	5	6
1*	2*	3*	4*	5*	6*

	Marks.	Dimensions.	Area.	Breaking Strains.		Elongation on 8 Ins.		Time.
		Inches.	Sq. Ins.	Actual.	Per Sq.In.	Inches.	Per Cent.	
				Tons.	Tons.			
Load applied quickly	No. 1	1·69 × ·225	·380	15·46	40·6	·98	12·2	2' 10"
,, ,, ,,	,, 2	1·69 × ·225	·380	15·35	40·3	·86	10·7	1' 15"
,, ,, ,,	,, 3	1·69 × ·225	·380	15·35	40·3	1·04	13·0	59"
,, ,, ,,	,, 4	1·69 × ·225	·380	15·40	40·5	·74	9·2	59"
,, ,, ,,	,, 5	1·69 × ·225	·380	15·57	40·9	1·16	14·5	2' 15"
,, ,, ,,	,, 6	1·69 × ·225	·380	15·66	41·2	·98	12·2	1' 20"
				Means...	40·63	...	11·96	1' 30"
Load applied slowly	No. 1*	1·69 × ·225	·380	15·04	39·5	·88	11·0	12' 27"
,, ,, ,,	,, 2*	1·69 × ·225	·380	15·33	40·3	·87	10·8	12' 9"
,, ,, ,,	,, 3*	1·69 × ·225	·380	15·13	39·8	·85	10·6	11' 56"
,, ,, ,,	,, 4*	1·69 × ·225	·380	15·08	39·6	·75	9·3	10' 50"
,, ,, ,,	,, 5*	1·69 × ·225	·380	15·04	39·5	1·02	12·7	11' 50"
,, ,, ,,	,, 6*	1·69 × ·225	·380	15·44	40·5	1·16	14·5	11' 48"
				Means ...	39·86	...	11·48	11' 50"

broke. Table I. shows the results afforded by a plate of a hard nature. From this plate twelve test pieces were prepared in the usual way, one half of them being tested as rapidly as possible, and the other half slowly. You will notice that the first series, broken in an average time of about a minute and a half, show an average of 40·63 tons of tensile strength, and 11·96 per cent. extension. The second series, broken in an average time of eleven minutes fifty seconds, show a mean tensile strength of 39·86 tons and 11·48 per cent. of extension. The difference is hardly worthy of mention.

In Table II. a similar set of experiments are shown carried out on a mild plate, and at three different rates of speed. Practically no difference is shown in the results. Both sets of experiments hint at a slightly less extension tested slowly than quickly. In the first series of the first set, Nos. 3 and 4 and peculiarly noteworthy as being broken under a minute. Yet the mean of their per-centages of extension is little affected, and the lowest is no lower than No. 4 of the second series, broken in ten minutes fifty seconds. In considering this it is worthy of remark that, to break the pieces in less than a minute, the hydraulic pump had to be worked full swing, throwing shock after shock on the machine, as was made evident by the violent vibrations of the test lever. From these results, I think, it may be assumed the time element, unless widely extended, is of little effect in the practical testing of steel.

Another set of experiments is shown in Tables III., IV. and V., and refer to the effects of simple annealing. Eight test pieces were cut from each of two quarter-inch plates, one known to be hard and one known to be very soft. After being prepared in the usual way, one half of each set of pieces was carefully annealed. In the hard plate we have a mean tensile strength unannealed of 32·97 tons, and a mean per-centage of extension of 16·65. The annealing reduced the mean tensile strength to 28·52 tons, or by 13·5 per cent., and raised the per-centage of extension from 16·65 per cent. to 24·12 per cent., or by 45 per cent. The soft plate showed unannealed 26·6 tons mean tensile strength, and 24·32 per cent. mean extension. Annealing lowered the tensile strength to 24·05 tons, or by 9·6 per cent., and raised the extension to 29·8 per cent.—22·6 per cent. of a rise. It is curious that the hard plate, although decreased in strength and increased in extension by annealing, showed no improvement in the bending test due to annealing. A similar set of experiments is shown carried out in Table V., upon a ½ in. plate of mild nature. The decrease in tensile strength shown here is not more than 5·6 per cent., and the increase in per-centage of extension does not exceed 7·3 per cent., the annealing being evidently less powerful for change in thick than in thin plates. However this may be, there are apparently two lessons to be learnt from the foregoing experiments, and these are, that hard plates may be brought within desired limits of strength by simple annealing, and that soft plates may be injuriously reduced by the process. This latter is a matter of serious moment, especially when we are, as now, dealing with steel of light tensile strength. If plates of 29 tons average strength are to be annealed, and thereby reduced to 26 tons, it is evident we shall end in working with a material in many parts of a ship of less strength than assumed in our calculations. On this account my firm have preferred the practice of rimelling punched holes, where such was required, to annealing the plates. The rimelling removes any bad effects of punching, and without lowering the general strength of the plate, which the annealing unquestionably does.

In connection with this matter of annealing, there very early arose a point with regard to the beam-knees of the steamers we were building, as to whether we should not anneal after finishing them. These beam-knees are split and welded in several heats, and Lloyd's authorities expressed some doubt as to whether it would be prudent to pass them without annealing as a whole. For a considerable time, therefore, we were in the habit of annealing the beam ends, but latterly we have not done so, and have had no cause to regret the change. Before making it we carried out a series of experiments on welded beam-knees, both of the common bulb and Butterley sections. Some were annealed entirely, some annealed in the knees only, and some unannealed. They were all subjected to a similar and very rough treatment, the knees being bent round flat on the beam, and the end of the knee doubled in upon it. No difference could be discovered between the behaviour of the different specimens; if anything, the completely unannealed beams having rather the best of it.

In Mr. Martell's Paper on Steel for Shipbuilding, he mentioned some successful attempts made by Mr. A. C. Kirk to shingle the scrap of mild steel into forgings. Mr. Kirk has, I believe, since that time continued to push this matter, and with considerable success. Following him, we have gone largely in for scrap-steel forgings.

(*To be continued.*)

BOILER EXPERIMENTS.

II.

An account of some experiments made at the Washington Navy Yard, on the 8 feet diameter cylindrical boiler used with compound engines in several steamers of the United States Navy.

By Chief Engineer ISHERWOOD, U.S. Navy.

(From *The Journal of the Franklin Institute.*)

MANNER OF MAKING THE EXPERIMENTS.

THE experiments were made in the following manner:—A clean anthracite fire of 9 in. thickness having been brought to steady action, with the steam blowing freely from the boiler escape-pipe—the safty-valve having been previously removed from its seat—the water-level in the boiler was adjusted to 6 in. above the top of the tubes, and the experiment held to commence. Each experiment continued exactly 12 hours, at which time the fire was thoroughly cleaned and made of the same thickness as at the commencement, with the water-level at the same mark.

During the continuance of each experiment, a tabular record or log was kept, in which was noted, at the end of each hour, the height of the barometer, the temperature of the air in the boiler-room, of the feed-water in the tank, and of the gases of combustion in the uptake, the latter being given by a metallic pyrometer. All the anthracite thrown into the furnace was carefully weighed, and all the refuse of ash, clinker and soot was likewise weighed on the same scales. After the completion of an experiment, the tubes were swept together with the other fire surfaces, so that experiment was begun with a clean boiler. The boiler being entirely new, its water surfaces were quite clean. The water fed into the boiler was first accurately measured in tank. The steam pressure in the boiler was found to be slightly in excess of the atmospheric pressure. All the experiments were made by the same personnel and in the same manner; the anthracite being burned at the maximum rate of combustion which could be obtained without forcing the fire.

The boiler was without any non-heat-conducting covering whatever, and was situated in the still air of the boiler-house of the Steam Engineering department of the Washington Navy Yard. Every precaution was taken to ensure accuracy in the results, and, also, that those from the different experiments might be fairly comparable. These results, and the data from which they were calculated, will be found in the following table.

The experiments were three in number. During the first, made on the 24th of May, 1873, all the tubes were in use. During the second, made on the 21st May, 1873, the lower twenty-one tubes—ten on one side of the furnace and eleven on the other—were tightly plugged at both ends, so as to prevent the passage through them of any of the hot gases of combustion, thereby reducing the heating surface 13·75 per centum, or from a proportion of 23·8750 square feet to 1·0000 of grate surface, to the proportion of 20·5926 to 1·0000; the calorimeter through the tubes being thereby reduced 17·65 per centum, or from a proportion of 1·0000 square foot to every 9·2443 square feet of grate surface, to the proportion of 1·0000 to 11·2255. During the third experiment, made on the 23rd of May, 1873, exactly the same reductions of heating surface and of calorimeter were made as in the second experiment, but, in this case, they were effected by plugging tightly at both ends, the twenty-one tubes composing the upper row—the plugs used in the second experiment having, of course, been removed from the twenty-one lower tubes. The absolute areas and proportions of the grate surface, heating surface, and calorimeter through the tubes, in both the second and third experiments, were precisely the same, the only difference being that the reduction in these particulars from the quantities in the first experiment, were made in the second experiment in tubes *lying below the top of the bridge-wall*, and in the third experiment in tubes *lying above the top of the bridge-wall.*

The first and second experiments, therefore, permit the determination of the effect produced on the absolute and economic vaporizations of the boiler, by the simultaneous reduction of its heating-surface and of its calorimeter through the tubes, its grate surface remaining constant, and all its heating-surface lying above the top of its bridge-wall.

In the third experiment, 15·94 per centum of the heating surface, and 21·43 per centum of the calorimeter through the tubes, lay *below* the top of the bridge-wall, therefore, experiments second and third permit the determination of the effect produced on the absolute and economic vaporizations of the boiler by this distribution;

the grate surface, heating surface, and calorimeters through the tubes being exactly the same in both experiments, the only difference being in the arrangement of the heating surface and calorimeter through the tubes relatively to the top of the bridge-wall. In the second experiment, all the calorimeter through the tubes was above that top; while, in the third experiment, only 78·57 per centum of the calorimeter was above that top. The grate surface and the calorimeter above the bridge-wall remained constant throughout, and the latter was so much larger than the calorimeter through the tubes that it exercised no influence on the results.

As the boiler, during all the experiments, had no covering to diminish the loss of heat by radiation from the external surfaces; and as boilers on which experiments are made, almost always have very efficient coverings for that purpose; it became necessary, in order that the results from this boiler may be comparable with those from other boilers, to ascertain the vaporizative value of the difference of the heat radiated in still air from the naked boiler and from the same boiler under the same conditions when covered with the usual protector of hair felt 1½ in. thick. This has been effected by means of the constants in a table constructed from experiments made for this object by the writer, and published on page 161 of the March number of the Journal for 1878. In that table, the number of Fahrenheit units of heat lost per hour per square foot of boiler plate per degree Fahrenheit difference of temperature between that of the steam upon one side of the metal, and that of the still air upon the opposite side, is 2·9330672 when the metal is naked, and 0·2507097 when the metal is covered with 1½ in. thickness of hair felt. The difference, 2·6823575 Fahrenheit units of heat, has been assumed in the case of this boiler, to have been lost per hour per square foot of the 204 square feet of its exposed external surface, per degree Fahrenheit of difference of temperature between the temperature of the steam inside and that of the still air in the fire-room outside of the boiler. From these data and the latent heat of the steam, the vaporizations in the table due to the loss of heat by external radiation, have been calculated; and these vaporizations have been added to those given by the direct tank measurement, in order to obtain the normal vaporizations. As the experimental boiler was in the same room with other and much larger boilers in use, the temperature of the air in that room as been taken as the proper temperature for the calculation, instead of the temperature of the external air.

(*To be continued.*)

On the night of 7th June a highly successful attempt was made at Portsmouth dockyard to light up the *Inflexible* dock by means of the electric light. The object of the trial was to ascertain whether it was practicable so to illumine the dock—a huge chasm 416 ft. long by 110 ft. in width and about 39 ft. in depth—as to make it possible in time of war or from any other urgent cause to dock an ironclad after dark, or to continue the work of completing her for sea throughout the night. The apparatus used on the occasion was one of Brush's dynamo machines, consisting of eight magnets and four powerful electro-magnets, and driven at a speed of 800 revolutions per minute. The lamps were also constructed on the Brush principle. Sixteen of these were placed in the same circuit in varions parts of the dock, while a seventeenth was placed in the electro-plating shop, near at hand, where the generating machine was fitted. At a quarter to 9 o'clock all the lamps were simultaneously lighted with positively startling results. The whole of the dock appeared to be instantly filled with daylight, rendering every part of the hull, keel, and bilges of the monster turret ship perfectly distinct, so that the workmen would have experienced no difficulty in pursuing their labours underneath the ship. The carbons, which are vertical, and about half an inch in diameter, burnt with a steady white light, without any signs of flame, and the most sensitive ear was unable to detect the least approach to the customary humming. The carbons will burn nine hours continuously without being changed—the renewal, however, being performed automatically; and the estimated expense, which has been confirmed by a day's continuous consumption, is 2½d. per lamp for four hours. The machine was driven by a 12½-horse engine, going at 120 revolutions a minute, the expenditure of coal being 10 cwt. for six hours. But as the coal was of inferior quality, and had been taken from the outside of the store, it is expected that under more favourable conditions the consumption for the 16 lights, each having a power of 2,000 candles, would not exceed 1 cwt. per hour. So pleased are the naval authoriries with the performances of the Brush system of lighting that the machines used for these experiments will be placed on board the *Minotaur*, and the captain's cabins, wardroom, engine-room, and stokehole will be lighted by electricity, the Wild light, with its low tension, being reserved for signalling and torpedo work.

STEAM LIFEBOAT.

ANOTHER step ahead has been made in the equipment of our men-of-war, though to casual observers the present improvement may appear less important than it really is. The advance, however, is highly significant, as showing the progressive development of steam propulsion and the multiplicity of uses to which a single boat may be applied. At the present time the fleet is provided with steam lifeboats varying from 42 ft. to 45 ft. in length, and which possess the prime quality that they will not capsize or sink if filled by a sea, there being more than sufficient buoyancy in the air-tight compartments to sustain the engines, crew, and weights. The air compartments, again, being built into and forming part of the structure of the boats, give great longitudinal and transverse strength, thereby enabling them to be hoisted up in davits, and rendering them available at all times. But, inasmuch as the speed realized by the largest of these twin-screw lifeboats has never exceeded 9½ knots—a very fair rate in the circumstances—they have been necessarily confined to the performance of what may be termed the domestic work of the ship. The Admiralty, however, being desirous of extending the usefulness of these small craft, commissioned Mr. John Samuel White, of East Cowes, to build six sea-going life-pinnaces of slightly larger dimensions, and which should realize a higher rate of speed than had yet been obtained from similar boats. The recent trials of these pinnaces at Portsmouth have been followed with great interest, and the results are in many respects remarkable. The boats measure 48 ft. in length (or 3 ft. more than the largest at present in use) 9 ft. 3 in. in breadth, and 4 ft. 9 in. in depth; and have a draught when all their machinery and gear are on board of 2 ft. 8 in. forward and 3 ft. 5 in. aft. They are built wholly of wood, and upon the diagonal principle, and are driven by compound engines, of which the high pressure cylinders are 7¼ in. and the low-pressure cylinders 11½ in. in diameter, having a stroke of 8 in. The screws, which are four-bladed, have a diameter of 3 ft. 2½ in., a mean pitch of 4 ft. 7½ in., and a length of 5¼ in. The boiler is fitted with a closed stokehole, the furnace being supplied with air by means of fans exactly after the manner of a torpedo boat. The total weight of the fully-equipped pinnaces is 152 cwt.—that is, 86 cwt. the machinery with steam up, and 66 cwt. the hull. When tried on the measured mile by the Dockyard authorities the engines developed 120 horses, with 340 revolutions per minute, and realized a mean speed of just over 13 knots, which is almost equal to the speed of the second-class torpedo boats, which, as a matter of course, can only be used for torpedo purposes. The steam pressure was at 120 lb., and the engines were worked expansively with the cut-off at 9-16ths of the stroke. The increase from 9½ to 13 knots at a bound has given great satisfaction, and, as the consumption of fuel has been reduced from 6 lb. to 3 lb. per unit of indicated horse power per hour, the additional speed has been obtained without any additional cost of coal, seeing that the power developed in the 45 ft. pinnaces was about 50. The question now arises whether these quick, light, and handy craft, which have had their fleetness greatly increased without injury to their special qualities as sea-going life pinnaces, could not be applied to purposes quite distinct from the ordinary work connected with a man-of-war, and thus help in freeing the decks and davits of an armour-clad from much of her present *impedimenta*. With a speed of 13 knots they will probably be found serviceable as patrol boats, and for assisting in defeating a torpedo attack. Whether they may be adapted for offensive torpedo purposes, and thus compete with the steel boats, is a matter for consideration, but it is unquestionable that, while they possess the speed of a 60 ft. torpedo craft in a straight line, their twin screws give them important advantages in respect of turning and going astern. With the rudder alone and with both engines going full speed ahead they can turn in from eight to ten times their length; but with one engine going ahead and the other astern they can go round in a distance equal to twice their length.

A NAVAL EXHIBITION.—A large and influential committee of Shipbuilders and Marine Engineers has been formed in Glasgow for the purpose of promoting an exhibition of Naval and Marine Engineering models in Glasgow. It is proposed that the exhibition shall be opened in the Corporation Galleries in November, and remain open for six months. Mr. James Panton, the superintendent of the Museum and Galleries, has been appointed secretary to the committee.—*Nature.*

THE ROYAL ALBERT DOCK.

THE Royal Albert Dock is the name given by the London and St. Katherine Dock Company to the largest dock in the world, which, constructed under the name of the Victoria Docks Extension, was opened June 24th by the Duke and Duchess of Connaught representing the Queen.

The great augmentation in the shipping trade in the Thames, and the ever-increasing size of the steamships both for merchandize and passenger traffic, have rendred enlargements in the extent of the dock and dock lock accommodation very necessary, and, perhaps, the presence of the *Orient* in the Thames a few months since gave the strongest illustration of the fact taken in connection with the knowledge that other passenger ships of equal size are being constructed. The new dock was really commenced toward the end of 1875, though at that time the intention was only to cut a ship canal from the present dock to Galleon's Reach, so as to get an entrance about three and a half miles lower down the river, and to save the navigation of two rather difficult bends. It was, however, soon seen that if a new and larger dock and lock were likely in future to be necessary, they would be much more cheaply constructed, instead of the canal, rather than after the canal was made and in use. The whole of the intended works was thns altered in character, and instead of a depth of 27 ft., as was proposed for the canal, the *Orient*, which draws 26 ft., showed the necessity for increasing the depth of the dock to 30 ft. The passage between the new and old docks is 80 ft. wide. The whole thus forms a magnificent dock 2¾ miles in length, and with an area of 175 acres.

When fully opened it will have two entrances from the River Thames—the present one at Blackwall Point, and the new one at Galleon's Reach, below Woolwich. The new entrance is constructed at the widest part of the river, and protected by two guiding jetties leading into the entrance lock; the curved part of these leading jetties is at the end of the entrance lock. This lock is about 800 ft. long over all, and 80 ft. wide, and has three pairs of wrought iron gates. The distance between the extreme gates is 550 ft., with a depth of 30 ft. of water over the sills of the outer and inner gates, below Trinity high water. The lock is thus capable of admitting not only the largest sea-going merchant vessels afloat, but any of the ironclads of the British Navy.

Immediately beyond this lock is an entrance basin of about 9 acres, leading into the main dock by a passage 300 ft. by 80 ft. in which is placed a pair of gates similar to those at the lock. so that this basin, when necessary, may be converted into a 9-acre dock. The passage is spanned by a swing-bridge, carrying the East Ham Manor-way across the new dock. The main dock has an area of about 75 acres, is about 1¼ miles long, and of a uniform width of 490 ft. between the copings.

The dock walls throughout the works are constructed entirely of Portland cement concrete, made from gravel found on the site. The aggregate length of dock and passage walls is about 3½ miles. The walls are about 40 ft. high, 5 ft. thick at the top, and from 18 ft. to 19 ft. thick at the base, requiring in their construction some half million cubic yards of concrete, representing 80,000 tons of Portland cement.

On the south side of the main dock, and near its western extremity, two large dry docks are being constructed, almost entirely of Portland cement concrete. The smaller dry dock is about 420 ft. long and 68 ft. wide between the copes, and the larger 510 ft. long and 84 ft. high. The sills of both are 22 ft. below Trinity high water. The larger dock is capable of admitting the largest ironclads of the *Kaiser*, *Deutschland*, and *Independencia* type. A short distance west of these docks a passage 80 ft. wide connects the extension with the older dock. Under this passage a tunnel 1,800 ft. long, exclusive of walled open cuttings, has been constructed for the North Woolwich branch of the Great Eastern Railway, the gradients of which are 1 in 50 from each end towards the centre, where the rail level is 43 ft. 6 in. below Trinity high water. In addition to this double line of railway passing under the dock, another double line of railway, as well as the East Ham-road, is carried over the passage by, perhaps, the largest swing bridge in the kingdom. It has a span of 90 ft., and weighs over 860 tons.

THE NEW DOCKS AT HOLYHEAD.

IN 1873 the London and North-Western Railway Company obtained an Act of Parliament for the enlargement of Holyhead Old Harbour.

Hitherto the traffic has been carried on at a one-sided station and quay, but what is now provided will give separate and distinct passenger platforms, quay walls, goods sheds, and sidings for the export and import traffic of the harbour and the up and down traffic of the railway.

The water area of the old harbour has been increased from 10½ acres to 24 acres, with a uniform depth of 13 ft. at ebb and 30 ft. at flood of spring tides, and 18 ft. and 23 ft. respectively at neaps. The length of quay has been increased to 4,000 lineal feet, and there are upwards of 15 miles of sidings; an additional goods shed, 750 ft. in length, has been constructed on the new quay, and the existing graving dock being inadequate for the company's steamers, a new one has been built with a length of 390 ft. along the keel-block line and a total length at coping level of 410 ft.; the entrance is 70 ft. wide at top and 64 ft. 6 in. at invert, where there is a depth of 15 ft. at high water of lowest neaps; the entrance in enclosed by a wrought iron caisson, which carries a line of railway from the company's station on the one side to the public quay on the other.

The company's fleet comprises 16 first-class steamers which, for speed, are of paddle-wheel contruction. Two new vessels have just been built by Messrs. Laird of steel plates made at the company's works at Crewe. An experimental trip was made with one of these vessels the other day, when a speed of 20 miles an hour was easily obtained.

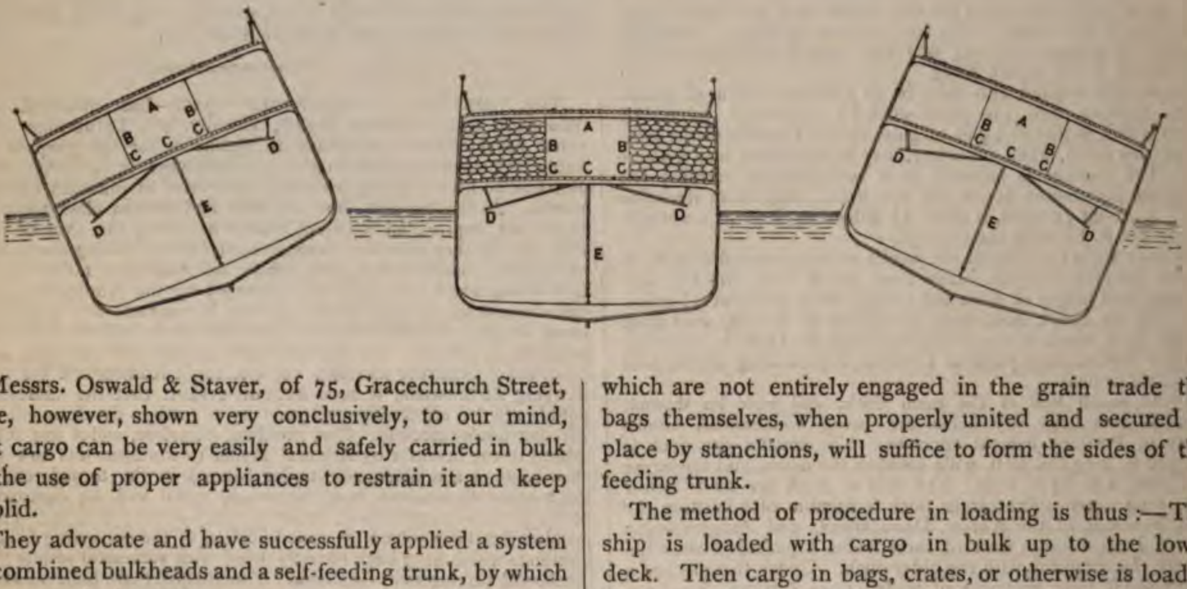
In conjunction with all this, the company have built an hotel replete with every comfort, commanding a fine view of the harbour and bay, where travellers may bide their time for fine weather, rest after a voyage, or sojourn for a day or two to see Holyhead and its surroundings, which should be better known by the general public. The breakwater alone is a sight, and the superb promenade upon it, stretching a mile and a half into the sea, is quite unequalled. Then again, an excursion along the coast to the famous "South Stack" will not soon be forgotten, and the sea bird's "Parliament-house" may be visited, where an amount of verbosity goes on perfectly confounding to landsmen, but of the greatest value as a warning to mariners when the lighthouse and rocks are enveloped in mist. The church at Holyhead is also curious, and is enclosed by walls supposed to be Roman.

The expenditure of the London and North-Western Company at this point will add greatly to the convenience of travellers taking this comfortable and short route, with its magnificent service of trains and steamers to and from the Sister Isle.

THE "BERTHON" COLLAPSIBLE BOAT.—Last month Lieut. Wonham, with Admirals Ryder, Hornby, and Lethbridge, and other naval officers, proceeded to Spithead, for the purpose of subjecting some bipartite dingies, manufactured by the Rev. Mr. Berthon on his collapsing principle, to a series of practical experiments. At the present time our first and second class torpedo boats are unprovided with any means of saving the lives of the crew should they from any cause be reduced to a sinking state, and as they are constructed of steel plates not more than 1-16th of an inch thick, which can easily be penetrated by the Nordenfelt gun, and stove in by collision or by coming in contact with a spar or other floating obstruction, the necessity for a lifeboat becomes painfully apparent. But as the decks of the torpedo craft are completely exposed, and are, besides, too circumscribed for the carrying of lifeboats, it soon became evident that the difficulty could only be effectually overcome by a furthur development of Mr. Berthon's principle. The problem, therefore, which was submitted to the inventor by Admiral Ryder to work out was how to stow boats of a sufficient size under hatches in the torpedo craft, the hatches themselves being extremely small and the compartments in which they were to be stowed only about 6 ft. long. The problem has been solved by a modification of the collapsing horse pontoons which have been recently tried with successful results by the Royal Engineers at Chatham. The lifeboats are built on Mr. Berthon's folding principle, and measure 12 ft. in length, 4 ft. 2 in. in beam, and 2 ft. in depth. They are divided into two parts, each of which will pass through an opening only 14 in. by 7 in., and when the halves are united (which requires less than half a minute of time) a very handsome life dingy is formed, capable of carrying the torpedo crew. Each half can be used singly. The parts can also be detached in the water, and if one half should be disabled in action it can be cast off and the retreat continued in the other. The little boats were put to some very severe tests. In about four minutes they were brought on deck, opened, united, fitted with thwarts, crutches, and oars, and launched. They were then manned by six men and towed at various speeds through the water for the purpose of testing their buoyancy and the strength of their connexions. The halves were afterwards disconnected and rowed by three men. The boats were finally lifted on board, collapsed, and stowed below in the after cabins in less time than it took to open them. The dingies were understood to satisfy all the conditions of the trial.

IMPROVEMENTS IN BULK CARGO VESSELS.

ONE of the most important problems of the day is how to safely and cheaply carry large cargoes in bulk of grain, coal, or other material liable to shift. Mr. Plimsoll has now turned his untiring criticisms upon bulk cargo vessels, and has produced startling statistical results as to the danger that grain or other bulk cargo vessels run. It is really startling to note what a very large proportion of the vessels "missing," and probably foundered, at sea, have been those carrying grain, or cargo in bulk. We think we may safely state, that the danger of a shifting cargo is certainly the greatest that can menace the safety of any vessel. Give a good seaman plenty of sea room, and a tight hull, and it will be an extraordinary gale that will give him the slightest anxiety as to the safety of his vessel. With a shifting cargo, however, he is never safe, and at the mercy of a very moderate storm. A ship's dangers from this cause are also increased by the very general adoption in iron vessels of water ballast.



Messrs. Oswald & Staver, of 75, Gracechurch Street, have, however, shown very conclusively, to our mind, that cargo can be very easily and safely carried in bulk by the use of proper appliances to restrain it and keep it solid.

They advocate and have successfully applied a system of combined bulkheads and a self-feeding trunk, by which the cargo is kept from moving, even under the most extreme oscillations from heavy weather, and is kept perfectly solid and motionless by automatic feeding as it settles down.

By referring to our illustrations it will be seen that the plan advocated is to fit a permanent or shifting longitudinal bulkhead throughout the whole length of the ship. If made permanent, this bulkhead will add greatly to the strength of the ship, as it gives her increased backbone or stiffness. The automatic feeding trunk arrangement can, however, be used with or without this bulkhead. In some cases where vessels have a very large grain-carrying hold, it is suggested to divide the hold into three parts, with two longitudinal bulkheads fixed to intercostal keels one on either side of the ship.

The between decks is further subdivided by two movable longitudinal bulkheads, B B, forming a central passage, A, down the decks. This is termed the feeding trunk to the hold below, and is in direct communication with the hatchways above, and by means of suitable openings, C C C, to the different compartments of the hold below. The openings into the hold are provided with shoots, D, which can fold up underneath the beams when not in use, and which are most serviceable for properly distributing the grain or bulk cargo. In fact, this arrangement of feeding trunk and shoots ought to considerably reduce the labour of loading, particularly when there is a grain hatch between the fore and main hatches. The hold is then self-trimming, the grain being evenly distributed.

It is intended that the between decks shall be loaded with grain in bags packed tightly away behind the movable bulkheads of the feeding trunk, or for vessels which are not entirely engaged in the grain trade the bags themselves, when properly united and secured in place by stanchions, will suffice to form the sides of the feeding trunk.

The method of procedure in loading is thus :—The ship is loaded with cargo in bulk up to the lower deck. Then cargo in bags, crates, or otherwise is loaded between decks before the trunk bulkheads are put up. These bulkheads can either be entirely removable or may fold in, under, or upon deck, so as to be quite out of the way when loading. When the sides of the between decks are filled up, the bulkheads are fixed in their place, and the feeding trunk is filled with grain or cargo in bulk. As the bulk cargo settles, and the vessel careens from starboard to port, the grain or cargo from the feeding trunk runs down the respective feeding shoots, and keeps the cargo solid and steady. At the same time the feeding trunk soon empties more or less at sea, so that it serves as a good ventilator to the cargo, and a very handy means of ingress and for examination. The emptying of the feeding trunk will also serve to lessen the top weight of the vessel. Thus Messrs. Oswald & Staver have, we think, most successfully used the dangerous settling of a bulk cargo as the direct means of effecting fresh packing, the reduction of top weight, and the improvement of ventilation and easy access, as the voyage proceeds.

TESTING STEEL FURNACE FLUES.—At the works of the Leeds Forge Company, Leeds, a series of tests to determine the ultimate resistance to collapse of welded iron and steel boiler furnace flues have been undertaken by the above-mentioned firm, under the guidance and supervision of the Board of Trade and Lloyd's Registry, for the purpose of determining the necessary thickness of plate in the case of corrugated furnaces. On Saturday the first of these tests was made. The furnace flue tested was a mild steel one, made on Fox's patent corrugated system. Its dimensions were:—Length, 8 ft. 1¼ in., of which a length of 7 ft. 9 in. was accurately marked off for the purpose of measuring the elongation. The distance between the centres of the exterior corrugations was 6 ft. 0½ in., these being 13 in number, 6 in. pitch, and about 2 in. through and through. In its original shape this flue measured at the centre diameter, vertically, 2 ft. 9⅞ in.; horizontally, 2 ft. 9⅝ in. At the third corrugation from the east end, the diameters were, vertically, 2 ft. 9 17-32 in.; horizontally, 2 ft. 9 1-16 in. At the third corrugation from the west end, vertically, 2 ft. 9 9-32 in.; horizontally, 2 ft. 9⅞ in. The thickness of the plate was ⅜ in. The pressures were ascertained by two guages, made by J. Dewrance, for the Marine Department of the Board of Trade, and one Schaeffer and Budenberg hydraulic guage. The deflection and elongation at different pressures were measured with sliding-rods by Mr. Peter Sampson, Engineer Surveyor for the Board of Trade; Mr. William Parker, Chief Engineer Surveyor to Lloyd's Registry, both of London; and Mr. Wilson Hartnell, on behalf of "Engineering." The pressures were raised by increments of 50 lb. per square inch to 550 lb., when the pressure was withdrawn, and it was ascertained that the flue had returned to its original shape, there being no set whatever. At 250 lb. per square inch the flue had only elongated 7-64ths of an inch, at 550 only 13-64ths of an inch, and collapsed vertically, outwards, 0·055 in.; horizontally, inwards, 0·065 in., the ends being free to move, and not fixed as they would be in a boiler. The pressure was then raised to 600 lb. per square inch, the measurements were taken, and the word given to proceed to 650 lb. On pumping being resumed, the flue began to scale and change its shape, when the pressure fell steadily back to 400 lb. per square inch. In its collapsed state the flue measured in the centre, vertically, 3 ft. 0 1-16 in.; horizontally, 2 ft. 7⅛ in., having thus become rather oval, the sides bulging in, and the top and bottom out. The pressure was then reapplied to ascertain the strength of the flue in its collapsed state, and a 350 lb. per square in. pressure was applied, without further collapsing the flue. At an early date the tests will be continued; plain, mild steel flues being the object of the next test. At the moment of collapse the aggregate pressure on the corrugated flue was 2,315 tons.—*Yorkshire Post and Leeds Intelligence.*

THE FRENCH MERCANTILE NAVY.—Returns have been published by the Minister of Agriculture and Commerce, showing the tonnage of the ships which entered and cleared the French ports in the first quarter of 1878, 1879, and 1880. The figures are 3,460,518 tons in 1878, 3,894,096 in 1879, and 4,371,355 tons in 1880, the increase in tonnage being over 12 per cent. in 1879, as compared to 1878, and more than 26 per cent. in 1880. Only two ports, Rouen and Nantes, showed a decrease in 1879, while Nantes is the only port which shows a decrease in the first quarter of this year; and Nantes, it should be observed, is much higher up the river than St. Nazaire, which is at the mouth of the Loire, and practically itself the Port of Nantes. Bordeaux shows an increase of 54 per cent. this year as compared to 1878; Rouen 44 per cent., Nice of 39 per cent., and Cette and Bayonne of 88 per cent., while Marseilles, which has nearly a fourth of the French shipping trade, had a tonnage of 1,131,359 tons this quarter, or 22 per cent. more than in the corresponding quarter of 1878. The same returns show that the tonnage of French ships has gone up from 1,232,648 tons in 1878 to 1,415,689 tons in 1880.

THE SCREW STEAMER ANTHRACITE.

IT is now many years since Mr. Jacob Perkins demonstrated the practicability of using steam at a very high pressure for the purpose of discharging bullets from a gun, by means of his steam gun, at the old Adelaide Gallery. Although the capability of steam for taking the place of gunpowder in this respect was then proved, the former has not yet superseded the latter in practice. Working still upon the high-pressure theory of Mr. Perkins, his descendants have followed up the principle in another and more promising direction—namely, in connexion with the steam engine. It has been left to the grandson of that gentleman, Mr. Loftus Perkins, to develop the theory to such a high degree of perfection as to bring it satisfactorily within the domain of practice. For several years past the Perkins system of using high-pressure steam has been in use both on land and in steam vessels with every success. The later instances, however, being more fully developed than the earlier, are naturally more perfect. The most recent example occurs in connection with a small vessel, the *Anthracite* which is the smallest steamer that has ever undertaken a voyage to America on her own unaided resources. The Perkins system consists of a tubulous boiler, in which steam is generated at a very high pressure, and a special system of engine in which the steam is used and re-used over and over again. The boilers are charged with fresh distilled water, a small quantity only being required, and this, after being converted into steam and used in the engine, is condensed and re-used. The advantages of the system are—a very small consumption of fuel, immunity from explosion by reason of the subdivision of the boiler into numerous parts, each part having a high resisting power, and durability of the boiler, which is equal to that of the engines and ship. The boiler is constructed of horizontal tubes, welded up at each end, and connected by small vertical tubes, and is proved to 2,500 lb. per square inch. The engine has three cylinders of different diameters, the smallest cylinder being placed over that of medium size, and being worked from the same piston rod. Steam is used at pressures ranging from 300 lb. to 500 lb. to the square inch, 350 lb. being the ordinary working pressure.

The *Anthracite* was built by Messrs. Schlesinger, Davis, & Co., of Wallsend, and was engined by Messrs. Hawks, Crawshay, and Sons, of Gateshead-on-Tyne. She is 84 ft. long, 16 ft. beam, and 10 ft. deep, her engine and boiler room being 22 ft. 6 in. long. Her gross tonnage is 70·26 tons, and her registered tonnage 27·91 tons. Her engines have three cylinders, of 8 in., 16 in., and 23 in. diameter respectively, with 15 in. stroke. They are of 20-horse power nominal, and 168-horse power indicated. The high-pressure and medium cylinders are single acting, the low-pressure cylinder being double acting.—*Times, May 27th.*

LAY TORPEDOES.—The manufacture of Lay torpedoes is being carried on with great energy in Russia, and several of these formidable weapons will, it is stated, be shortly completed and forwarded to the chief ports on the Baltic and Black Sea. The Lay, like the Whitehead, is a locomotive torpedo; but while the latter, after it is once launched, is no longer under control, the movements of the former can be guided and directed throughout its course. At the will of an operator on shore, or on board a ship, if the torpedo is discharged from the latter, it can be made to turn to the right or left, to rise or sink in the water, to explode at any moment, or finally, should it fail to reach the object against which it is sent, it can be brought back again to the point from which it started. A few months ago some very successful experiments were carried out with Lay torpedoes in the Scheldt, near Antwerp, when one of them was sent against a boat anchored 3,000 metres, or very nearly two miles, from the operator on the bank of the river. To reach its mark the torpedo had in the first instance to move along a line of buoys at an oblique angle to the current, and had then to turn on to a course at right angles to the direction it had been previously taking; and this difficult feat it successfully accomplished. That a torpedo which can be thus kept under control up to the very moment when it becomes desirable to explode it must prove extremely valuable for coast defence purposes is very obvious; and therefore it may be assumed that it will soon be adopted by other countries besides Russia.

THE OCEAN PALACE STEAM SHIP.

WE are so proud of our enormous ocean-going liners that we are apt to think that we have reached the height of perfection, and that a voyage of 38 days duration to the Antipodes cannot be surpassed. We are apt to forget that the present acme of perfection has been obtained by steady and continuous improvement, and there is not the slightest reason to suppose that the world is ever going to stand still in its course of invention, discovery and improvement.

We herewith wish to draw attention to what seems to us a very feasible design for palace ocean-going steamers, which might be capable of completing the voyage to Australia in say 25 or 26 days, that is to say, by an increase of speed of some 75 per cent. This improved system is the patented invention of Mr. Robert Wilcox, of Melbourne, Victoria, for we are indebted to his agents, Messrs. Collyns & Co., for the details we herewith lay before our readers. Mr. Wilcox seems to be thoroughly acquainted with the first principles of liquid resistance and buoyancy as defined by our greatest modern authority, Professor Froude, and it is upon these expressed principles that he has designed his very curious form of hull to give the least resistance with greatest buoyancy and stability.

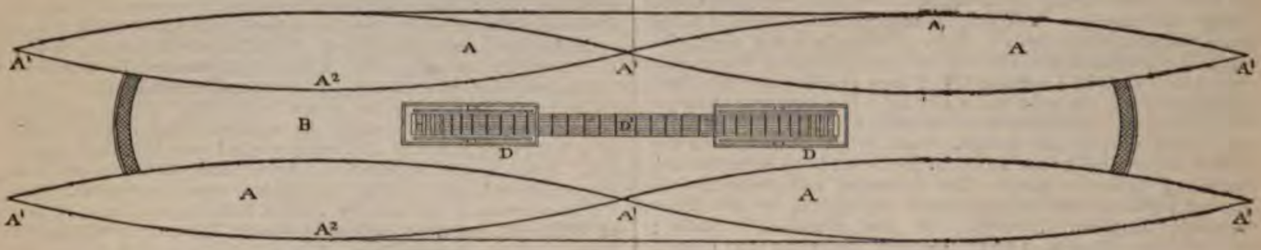


Fig: 2.

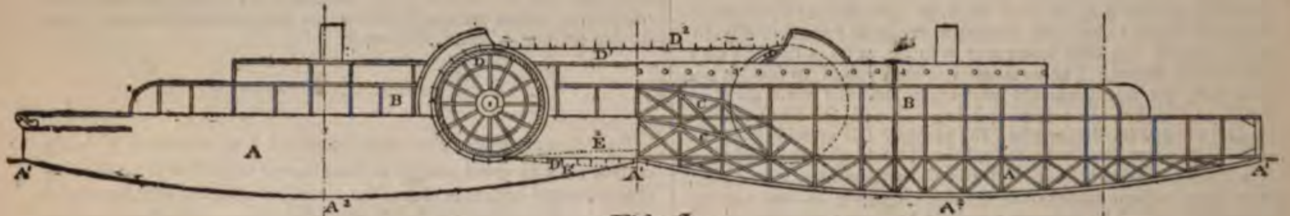


Fig: 3.

That any change which would confer a reasonable shape to the present wall sided cargo steamers must be an improvement will, we think, be immediately granted by all ship-owners, sailors, and ship-builders. It is well known that scientific proportions are almost entirely sacrificed in our mercantile marine to cargo carrying capacity, and if the requisite capacity can be obtained without sacrifice of the best proportions and cleanest run aft, the sooner it is effected the better would all parties be pleased. It must be self-evident that with the present wall-sided steamers a sea strikes against a perpendicular surface when it strikes a beam or broadside. The sea has little chance with such a wall-sided vessel of either breaking under the hull or of running free towards stem or stern, whereas the vessel we illustrate is particularly designed to allow of this.

The different heads of resistance to a ship's speed may be classified as follows :—1st. Surface friction, which is now acknowledged to represent as much as 80 to 90 per cent. of the total resistance. 2nd. Wave resistance which has never been accurately estimated. 3rd. Residuary resistance caused by the wave of replacement not being able to exert its full forward pressure upon the ordinary wall sides of vessels. 4th. Mutual resistance, produced by eddies of water caused by bluff entrances, or runs and roughness of surface.

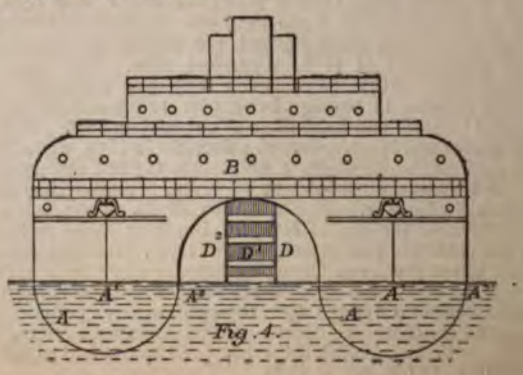
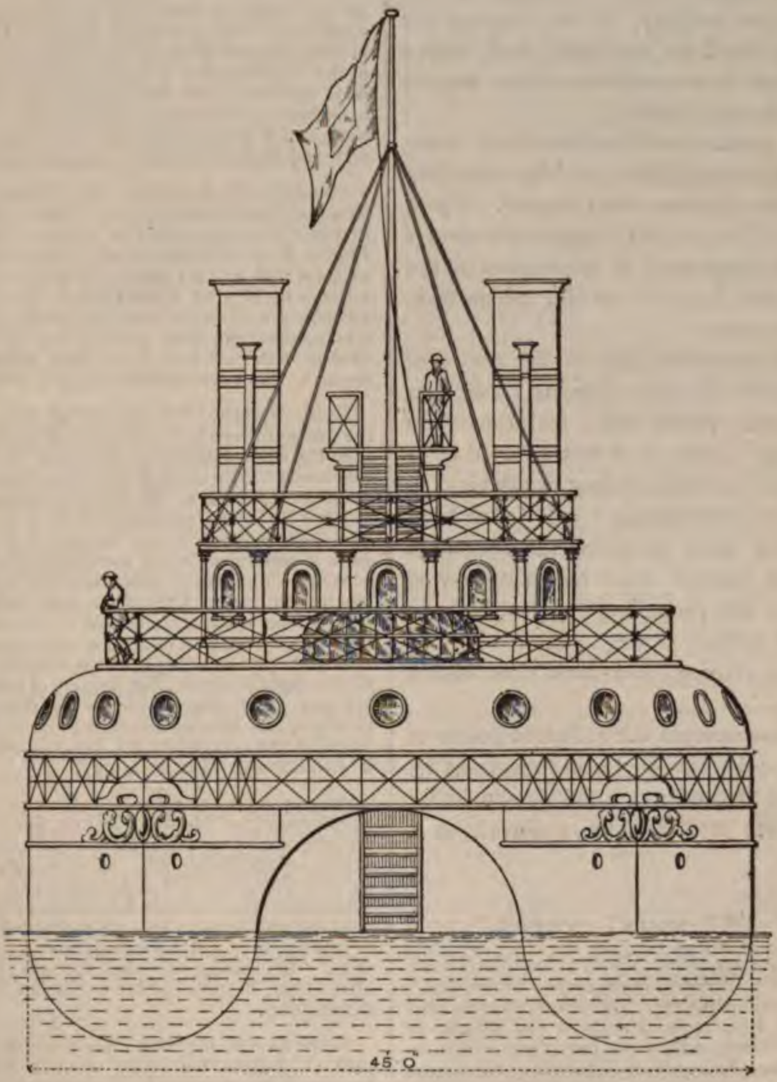


Fig. 4.

To construct a vessel, which shall, as far as possible, meet the above requirements for absence of resistance, Mr. Wilcox employs a double hull, each of which is divided into two cigar-shaped portions, as seen in our illustration at A. The proper width apart for these hulls has been determined by direct experiment, and the resistance offered by the compound hull has found, capacity for capacity, to be much less than that of the usual wall-sided hull. The particular advantages claimed for this form of hull are these. The surface friction is not large, whilst the buoyancy is very great. The wave of replacement is allowed to re-enter under the forward portion of the hull immediately, so as to exert its full forward force caused by the external friction. The second hulls then have the further advantage of entering on moving water, so that the proportional resistance of the latter part of the hulls should not be great. That there is something in this idea may be gathered from the fact, that it is not so difficult to tow a series of barges in a single line, stem and stem, as if they were arranged abreast. Should waves strike this vessel abeam or broadside, or there are rapidly entering curves both under the hull and to the centre and end of the vessel, so that the wave will pass readily under, and one might almost say, through the centre of the vessel. The excessive breadth of beam of the double hull also gives such a great leverage to the buoyancy that the vessel would easily rise to broadside seas.



The method of propulsion adopted by Mr. Wilcox is also very novel, and seems eminently calculated to give an exceptionally-effective grip to the water. He places a couple of enormous drums fore and aft, which are driven by the engines as if they were paddle wheels. Over these drums is placed a continuous band of iron links upon which, at suitable intervals, are fixed the paddles or blades, as seen at D D in the illustrations. A comparatively low speed of engine will give a high speed of velocity to this band of blades and as there will be 21 paddles all immersed at the same time, their grip of the water should be so good that there should be little slip.

Owing to the enormous breadth of beam of this vessel, and its consequent stability, all the engines and boilers may be safely fixed on the main deck above water, and the passenger decks and state rooms may be carried up to several tiers as shown.

The height of the engines and boilers above water should render them very secure against sudden swamping even should the vessel become water logged. There is no doubt that one of the greatest dangers to steamers at present is the rapid disablement of the engines by the extinguishing of the boiler fires, in case of a sudden leak, or swamping by heavy seas.

The position of the propelling gear in the centre of the vessel is advantageous in three respects. 1st. It is entirely protected from violent seas, and thus little likely to receive damage. 2nd. It is not affected as to its depths of immersion by either rolling or pitching, so that there can be no danger of racing. 3rd. It has been found that a following wave of replacement collects between the hulls and remains there constant, moving with the vessel, so that the propelling paddles will have all the advantage of driving through water which is advancing rather than retiring, and may thus obtain "positive slip."

We think that we have pointed out sufficient points of material advantage in this form of vessel to warrant its serious investigation by ship owners; and we should be extremely pleased to see it practically employed on a large scale.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Osmanli.—On the 24th of May the *Osmanli*, an addition to the steamship fleet of Messrs. James Moss & Co., of Liverpool, was launched by Messrs. C. Mitchell & Co. from their yard at Low Walker. The vessel is 330 ft. long between perpendiculars, and is built to class 20 years at Liverpool. She is fitted with topgallant forecastle from long bridge amidships extending beyond the length of the engine-room. Immediately after the launch she was towed up to Messrs. R. & W. Hawthorn's shears to be there fitted by them with engines of 250-horse power, embracing all recent improvements.

Menai.—On the 25th of May there was launched from the iron shipbuilding-yard of Mr. Robert Foster, South Dock, Sunderland, an iron sailing ship, built to the order of the Arvon Shipping Company, Caernarvon, of the following dimensions:—Length, 241 ft.; breadth, 36 ft. ½ in.; depth in hold, 22 ft. She is fitted with full poop, topgallant forecastle, and deck house, built to the highest class in both Lloyd's and Liverpool Underwriters' Registry, fitted with patent capstan, windlass, and all other latest improvements. On leaving the ways the vessel was named the *Menai* by Miss Foster, of Sunderland.

Laomene.—On the 26th of May, a new iron clipper ship was launched on the Mersey by Messrs. W. H. Potter & Son, from their shipbuilding and engineering works, Queen's Dock. The vessel is of the following dimensions:—Length, 275 ft,; beam, 39 ft.; depth in hold, 24 ft.; tonnage, builder's measurement, 1,955 tons. She is classed 100 A at Lloyd's, and 20 years in red in the Liverpool Underwriters' Book, and her scantling is in excess of the requirements of both these books. As the vessel left the ways she was named the *Laomene* by Miss E. J. Fernie. She has been built to the order of Messrs. Henry Fernie & Sons, of Liverpool, and is intended for their line of vessels sailing between Liverpool and Melbourne, Rangoon, and San Francisco.

Chonila.—On the 26th of May, Messrs. Thomas Brassey & Co., launched from their premises, Canada Works, Birkenhead, a new iron auxiliary steam yacht of 125 tons, built to the order of Henry Pigeon, Esq., of Hythe, Hants, under the special survey of Lloyd's to class 100 A. As the vessel left the ways she was christened *Chonila* by Mrs. St. Clare Byrne. The principal dimensions of the *Chonila* are—Length over all, 108 ft.; length on load-line, 92 ft. 6 in.; beam moulded, 16 ft. 8 in.; depth moulded, 10 ft. 5 in.; draft of water aft, 8 ft. 6 in. She will be fitted with compound engines. The *Chonila* will be rigged as a schooner with pole masts.

Cattle Steamer.—On the 26th of May a screw steamer, built to the order of Messrs. W. Johnson & Co., of Liverpool, was launched from the shipbuilding-yard of Messrs. W. Doxford & Sons, Pallion, Sunderland. The steamer has been specially built for the American cattle trade, and is of the following dimensions:—Length over all 342 ft.; breadth (extreme), 36 ft. 6 in.; depth amidships, from under side of deck, 26 ft.; her nett register is 1,700 tons, and her gross measurement 2,600 tons. The vessel has a very large cargo capacity, and is fitted with water ballast tanks capable of stowing 660 tons of water. One of the water ballast tanks is available for cargo space, when water ballast is not needed. The steamer has a full poop, bridge and forecastle, and is classed 100 A 1 at Lloyd's. She is likewise fitted with steam winches, and all the requirements for the rapid reception and delivery of cargo, as well as steam steering gear. The engines are on the compound surface condensing principle, and have cylinders of 40 in. and 73 in. and 48 in. stroke. There are two double-ended boilers, both of which are 12 ft. 6 in. in diameter and 18 ft. 6 in. long.

Premier.—On the 26th May there was launched from the ship, building-yard of Messrs. Raylton, Dixon & Co., Middlesbrough, the first of two steamers, built to the order of Messrs. Ed. Harris & Co., of Middlesbrough. These vessels will carry about 960 tons on 14 ft. draught of water, and will be schooner rigged. They have long raised quarter deck, main deck of iron, water ballast in after hold and engine room, two steam winches on deck, and deck houses of iron. They will have engines of 75-horse power placed amidships. On leaving the ways she was christened the *Premier* by Miss Fidler, daughter of Mr. Councillor Fidler, one of the principal shareholders.

Flavian.—On the 26th May there was launched from Palmer's yard at Jarrow the screw steamer *Flavian*, built for Messrs. Leyland & Co., Liverpool. The vessel measures 345 ft. by 33 ft. 3 in. in breadth, and 23 ft. 11 in. depth of hold. She is classed the highest class in the Liverpool Underwriter's Registry, and is of extra strong construction. The *Flavian* is intended for the general Atlantic and Mediterranean trades, and will have a carrying capacity of about 3,000 tons. She will have accommodation amidships for first-class passengers. The engines are Mr. G. Alliban's patent four cylinder engines of about 250-horse power nominal. The steamship was christened by Miss Dinah Armstrong, daughter of Mr. Robert Armstrong.

New Minster.—On 27th May there was launched from Palmer's yard at Jarrow the screw-steamer *New Minster*, built for a new partnership of which Mr. J. E. Bowser, Quayside, Newcastle, is managing owner. The dimensions of the steamer are: Length, 270 ft. by 35 ft. by 23½ ft. She is built on the three-deck principle, the main decks being of iron, and is classed 100 A 1 at Lloyd's—the highest class. The *New Minster* is intended for the Indian, Atlantic, and general trades, and will possess a carrying capacity of about 2,000 tons deadweight. The ceremony of naming the *New Minster* was performed by Miss Bowser, daughter of the managing owner.

Gitano.—On the 27th May a new steamer, built to the order of Messrs. Wilson, Sons, & Co., of Hull, was launched from the yard of Erle's Shipbuilding Company, at Hull. This vessel is the first steel vessel built by the company, manufactured on the Martin Siemen's process by the Steel Company of Scotland. She is 240 ft. long and 33 ft. broad, with 17 ft. depth of hold. She has a tonnage of 1,800 tons, and will steam nine knots per hour. Her engines will be of the single crank type, the high pressure cylinders being over the low pressure. The ceremony of christening was performed by Mrs. Hodgson, the wife of Messrs. Wilson's cashier, the vessel as she slid down the ways receiving the name of *Gitano*. She is sister ship to the *Silvio*, which has just made her first voyage, the only difference in the two being that the *Gitano* is of steel, whilst the *Silvio* is an iron vessel.

Waterwitch.—On the 27th May the *Waterwitch*, Mr. E. C. Baring, of the Royal Yacht Squadron, was launched from the yard of Messr.s Camper & Nicholson, at Gosport. The new yacht, which is of 162 tons burthen, with 20 tons of lead on the keel, has been built for racing purposes, and is expected to take the place of Mr. Baring's *Nixie*, 80 tons. She is to be commanded by Mr. R. Gomes, and to be ready for sea by the middle of June. Classed A 1, 18 years at Lloyd's, she is 100 ft. long, with a beam 19 ft. 2 in., and a depth of hold of 12 ft. 3 in., and she draws 12 ft. 2 in. a foot. She is to be a schooner yacht, is built of oak, and is smartly sparred, and she is intended to be a fast cruiser. She was christened at high tide by Miss E. Baring, daughter of the owner.

Clydach.—On the 29th May Messrs. Osbourne, Graham, & Co., launched from their yard at Hylton a iron screw steamer, built to the order of a Cardiff firm, and of the following dimensions:—220 ft. by 31 ft. by 13 ft. 4 in. to top of tanks, and she will class 100 A 1 at Lloyd's. She has been built on the cellular system of tanks for water ballast fore and aft, and will be provided with compound engines by the North Eastern Marine Engineering Company of 100 nominal horse-power, and has been fitted with all the latest improvements and appliances for facilitating the loading and discharging of cargoes. On leaving the ways she was named the *Clydach* by Miss Edith Moore, of Sunderland.

Girl of Devon.—On the 8th June there was launched at Plymouth, from the yard af Mr. W. H. Shilston, Coxside, a three-masted schooner, intended for the Newfoundland and Mediterranean trades. She is 136 tons register, and classed 12 years A 1 at Lloyd's, owned by her builder, Mr. Shilston, and to be commanded by Captain W. Grant. As she left the stocks she was named the *Girl of Devon* by Master A. Shilston, the builder's son.

Mooltan.—On the 8th June an iron sailing-ship was launched from the building-yard of Messrs. Richardson, Duck, & Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length over all, 262 ft.; length between perpendiculars, 244 ft.; breadth extreme, 39 ft.; depth in hold, 24 ft. 3 in.; tonnage, gross, 1,724 tons; tonnage, nett, 1,666 tons. She is classed 100 A at Lloyd's, and 20 years in the Liverpool registry; has a full poop and topgallant forecastle, will be ship-rigged and fitted up in the poop for the accommodation of the captain, officers, and four first-class passengers. The vessel has been built to the order of the British and Eastern Shipping Company (Limited), of Liverpool, and is the fourth vessel built for the same owners by Messrs. Richardson, Duck, & Co. She is intended for the East India trade. As the vessel was leaving the ways she was christened the *Mooltan* by Mrs. Macdonald, of Birkenhead.

Ibex.—On June the 9th Messrs. Edward Withy & Co. launched from Middleton Ship-yard, West Hartlepool, an iron screw-steamer, built to the order of Messrs. Cory, Lohden and Jacksons, of London. This vessel is No. 87 in the builder's yard, is the sixth built for the same firm, has large deadweight capacity, and is intended for the Mediterranean and Indian trades. Her principal dimensions are:—Length b.p., 245 ft.; beam extreme, 34 ft.; depth of holds to Lloyd's height of floor plates, 17 and 21 ft. She has a double bottom all fore and aft on the "Longitudinal and Bracket System," and has been built under Lloyd's special survey for the 100 A1 class. She has topgallant forecastle, and a quarter-deck joined to a long midship bridge-house; all her decks, as also the chart-house, engine-room skylight, and cabin companion are of iron, and she will be rigged as a topsail-schooner. Her engines, of 130-horse power, will be supplied by Messrs. Blair & Co., of Stockton, and patent combination windlass by Emerson, Walker & Co., London. As the steamer left the ways she was christened *Ibex* by Mrs. Lohden.

Grand Duchess Olga.—On the 10th June a steel passenger steamer was launched from Messrs. A. Leslie's yard at Hebburn, and named the *Grand Duchess Olga* by Miss Coote, of Newcastle. It has been built to the order of the Russian Steam Navigation and Trading Company, and is for the Crimea Caucasus Line. The dimensions of the vessel are:—Length, 260 ft.; beam, 34 ft.; depth, 24½ ft.; tonnage, about 1,000 tons; class, 1000 A at Lloyd's. The engines are built by Messrs. Maudsley, Sons & Field, London, and are of 300 nominal horse power. The vessel will be fitted up to carry 500 first and second class passengers.

Kaiser and Parklands.—On the 10th June, Messrs. W. Gray & Co. launched from their yard at West Hartlepool two screw steamers. The first has been built to the order of the West Hartlepool Steam Navigation Company, and is for the West Hartlepool and Germany passenger trade. Her dimensions are:—Length between perpendiculars, 220 ft.; breadth, 28 ft. 6 in.; and depth, 16 ft. and 23 ft.; engines, 130-horse power, are by Messrs. T. Richardson & Sons, Hartlepool; classed highest at Lloyd's. As she left the ways she was christened the *Kaiser* by Miss Francis Mary Young, daughter of Captain Young, the Managing Owner. The second steamer has been built to the order of Messrs. R. Ropner & Co. Her dimensions are:—Length between perpendiculars, 256 ft. 6 in.; breadth, 34 ft. 6 in.; and depth, 19 ft. 8 in. and 24 ft. She is classed 100 A1, and built under the special survey of Captain C. Bowden Rooke; her engines will be 150-horse power, built by Messrs. T. Richardson & Sons, Hartlepool, her gross tonnage being 1,750 tons, with a carrying capacity of 2,350 tons. She was christened the *Parklands* by Miss Lilian Ropner, daughter of Major Ropner, the Managing Owner.

Red Rose.—On the 12th June, the *Red Rose*, iron screw-steamer, built for Captain Peter Rowe, of Cardiff, was launched from the works of Messrs. Schlesinger, Davis & Co., Wallsend. Her dimensions are:—Length, 240 ft.; breadth, 32 ft.; and 18½ ft. depth of hold. She classes 100 A1 at Lloyd's, and has been built under special inspection, and will be fitted with every requisite for quick and efficient working. The engines are supplied by Messrs. Hawks, Crawshay & Sons, of Gateshead; the cylinders are 28 and 53 in. diameter, with a stroke of 36 in., and have been constructed under the superintendence of Mr. J. R. Powell, consulting engineer, Cardiff. The christening ceremony was performed by Mrs. Seymour, the eldest daughter of Captain Rowe.

Douro.—On June 19, Messrs. Oswalde, Mordaunt & Co., launched from their yard at Woolston, a screw steamer for Messrs. Leyland & Co., of Liverpool, of the following dimensions:—Length, 210 ft.; breadth, 27 ft. 3 in.; depth of hold, 17 ft. The vessel is built especially for the cattle trade, with fittings for 240 head of cattle, and is classed 20 years red in the Liverpool Underwriters' book, and will take Board of Trade certificate. She is fitted with iron main deck fore-and-aft, and large hurricane-house amidships for Officers and eight passengers, and topgallant-forecastle for crew and firemen, and is schooner-rigged. She has two powerful steam winches for working cargo. The engines, of 100-horse power nominal, cylinders of 26 and 52 with 33 stroke, are of the high pressure surface-condensing direct-acting type, and built by the same firm. On leaving the ways the *Douro* was christened by Miss Mordaunt, the eldest daughter of J. M. Mordaunt, Esq., one of the builders.

Severn.—The Barrow Shipbuilding Company last month launched from their yard at Barrow a steam yacht, built to the order of Earl Ducie. She was named the *Severn*, and is of the following dimensions:—Length between perpendiculars, 135 ft.; breadth moulded, 22 ft.; depth moulded, 12 ft. 6 in.; registered tonnage, 314 B.M. Her engines are a pair of direct-acting inverted surface condensers, and she is expected to steam 11 knots per hour. She was launched with steam up and steamed with her own power into the docks at Barrow.

The Constance, 14 guns, screw corvette, was launched at Chatham dockyard on the afternoon of June 9th, in the presence of some thousands of spectators, notwithstanding that the weather was very unfavourable. The vessel is constructed of steel and iron, is cased with wood, and is the first vessel launched at Chatham in which steel has been chiefly used. Several vessels of a similar class are under construction at the other dockyards. The Constance will carry no armour, being intended more as a fast cruiser than as a fighting ship, and, as she is to be fitted with engines of 2,300-horse power—her tonnage being 2,383 tons—it is expected she will have a very high rate of speed. The principal dimensions of the vessel are as follows:—Length between perpendiculars, 225 ft.; extreme breadth, 44 ft. 6 in.; draught of water, forward, 17 ft.; aft, 18 ft. 6 in. She will carry two 90 cwt. guns and twelve 64-pounders; and will have a complement of 251 officers and men, all told. Among those present at the launch were Mr. Brassey, M.P., Vice-Admiral Sir R. J. Macdonald, Commander-in-Chief at the Nore; Rear Admiral T. Brandreth, C.B., superintendent of Chatham Dockyard; Capt. W. Hunt-Grubbe, in command of the Medway Steam Reserve; Col. Sir J. Stokes, R.E., and Col.-Commandant Connolly, R.M.L.I. The service appointed for launches was read by the Rev. W. E. Smith, chaplain of Chatham Dockyard, after which the christening ceremony was performed by Miss Macdonald, daughter of Admiral Macdonald. At the time the vessel should have left the slip a slight hitch occurred. Miss Macdonald had severed the rope holding the weight which was to knock away the dog-shore and so release the ship, but the weight failed to knock the dog-shore away, and, consequently, the vessel hung. Mr. R. P. Saunders, the chief constructor, and Mr. Stainer, the constructor, who were superintending the launch, at once ordered men to knock it away with sledges; but the whole weight of the ship being upon the dog-shore, they could not move it, and the only resource was to cut it through. This having been done, the vessel went off immediately amid loud cheering. About ten minutes elapsed from the time of the weight falling and the vessel leaving, and considerable anxiety was manifested until she began to move. When in the river she was taken in tow and safely moored. She will be brought forward for commission as soon as possible. After the launch, the dockyardmen were granted a holiday for the remainder of the day.

LAUNCHES.—Scotch.

Woodstock.—On the 25th of May the *Woodstock* was launched at Leith by Messrs. Ramage and Ferguson. She is a steamer of 800 tons burthen, built to the order of Messrs. George Gibson & Co., of Leith, for their Continental trade. She will have engines of 85-horse power, by Messrs. Fleming & Ferguson, of Paisley.

Speedwell.—On the 25th May Messrs. Murdoch & Murray launched at Port Glasgow the last of four screw steamers to the order of the Great Northern Fish Carrying Company. She was named the *Speedwell*, and is of the following dimensions:—Length, 130 ft.; breadth of beam, 21 ft.; depth of hold, 11 ft. Messrs. Muir & Houston, Glasgow, supply a pair of surface-condensing compound engines, with cylinders of 20 and 40 in. in diameter, and a 27 in. stroke. The names of the other steamers are the *Progress*, the *Onward*, and the *Vigilant*.

Sovereign.—On the 25th of May, the *Sovereign*, a schooner of 103 tons, was launched at Peterhead by Messrs. Carnegie & Mathew. The following are her dimensions:—Length, 90 ft.; breadth, 20 ft. 6 in.; depth of hold, 10½ ft. She has been purchased by Mr. George Stephen, merchant, Fraserburgh, and will be engaged in the Baltic and Mediterranean trades.

Sea Queen.—On the 25th May there was launched rom the shipbuilding-yard of Messrs. Robert Duncan & Co., Port Glasgow, a steam yacht, built to the order of Mr. Galbraith, of Beach House, Wemyss Bay. The new vessel is of the following dimensions:—Length, per register, 195 ft., and from figurehead to taffrail 210 ft.; extreme breadth, 25 ft.; depth (moulded), 16 ft.; and depth from the bottom of keel to rail amidships, 21 ft.; and height of 'tween decks, for cabins, 8 ft. She is a vessel of about 565 tons Thames Y.M., and her registered tonnage about 365. She will draw 13 ft. 6 in. of water aft, and 11 ft. forward. Messrs. Rankine & Blackmore, of Greenock, are to supply her with compound engines of 100-horse power; the cylinders are 24 and 46 in. diameter by 26 in. stroke; the boiler 14 ft. 6 in. diameter by 10 ft. long, and will be loaded to 90 lb. working pressure, capable of indicating over 500-horse power in regular work, with a speed of about 13 knots an hour under steam alone. It is intended that the vessel shall be a sailing as well as steam yacht, and for this purpose, besides her powerful machinery, she is fitted with strong spars and sails, in order that advantage may be taken of any favourable wind when on a cruise. The hull has been so constructed that she has a double bottom for water ballast, which is a novelty in the construction of yachts. The yacht's bunkers are capable of holding 100 tons of coal, and under the cabin floor there is a large space in which 50 tons more can be stowed when necessary. Lengthwise the vessel is divided into five compartments by iron water-tight bulkheads. As the vessel left the ways she was named the *Sea Queen* by Miss Jessie Galloway.

Cynthia.—On the 26th May, Messrs. David and William Henderson & Co., launched from their Meadowside Works, Partick, an iron screw steamer of 2,150 tons, and of the following dimensions:—Length, 320 ft.; breadth, 36 ft. 6 in.; depth, 26 ft. She has been built to the order of Messrs. Donaldson Brothers, 67, Great Clyde-street, and will form one of their Canadian and South American fleet of steamers. On leaving the ways she was named *Cynthia*, by Miss Donaldson, Beechwood House, Partick. The *Cynthia* has been built under special survey, and will be furnished by her builders with compound machiney of 200 horse power.

Glen Etive.—On the 26th May there was launched from the shipbuilding-yard of Messrs. T. B. Seath & Co., Rutherglen, a little steamer intended to ply on Loch Etive, in connection with the new tourist route by the Oban Railway. Her dimensions are:—Length, 82 ft.; breadth (moulded), 12 ft.; depth (moulded), 6 ft.; and she has a promenade deck 52 ft. long, while the fore-cabin is 18 ft., and the after-cabin 10 ft. in length respectively. The vessel, as she left the ways, was named *Glen Etive*.

Washington.—On the 26th May Messrs. Alex. Stephen & Sons, Linthouse, Govan, launched the *Washington*, a mail steamer of 3,000 tons, class 100 A 1 at Lloyd's, and fitted, before launching, with compound surface-condensing engines of 370 horse-power nominal. The *Washington*, which has been built to the order of Messrs. J. and V. Florio & Co., of Palermo, is a sister ship to the *Vincenzo Florio*, recently completed by the same builders for that firm, and will be commanded by Captain Diliberto. The vessel has provision for water-ballast in double bottom on the bracket principle. Miss Maud Stephen performed the ceremony of naming the steamer.

Abd-el-Kader.—On the 26th May Messrs. John Elder & Co. launched, from their Shipbuilding and Engineering Works at Fairfield, Govan, the *Abd-el-Kader*, a French mail and passenger steamer for the Compagnie Générale Transatlantique. The *Abd-el-Kader* is the third of the four steamers for which Messrs. Elder & Co. obtained the order in November last. The *Abd-el-Kader* is exactly similar to the *Moise* and *St. Augustin* recently launched by Messrs. Elder & Co., and the principle dimensions of the vessel are:—Length between perpendiculars, 313 ft. 6 in.; breadth 33 ft. 6 in.; depth moulded, 25 ft. 6 in.; tonnage, gross, about 1,860 tons. The engines are on the compound principle, with inverted cylinders, and surface condensers. The high pressure cylinder is 42 in. diameter, and the low-pressure cylinder 80 in. diameter, the stroke being 4 ft. Steam is supplied by two circular double-ended boilers, of 13 ft. 6 in. diameter, and 17 ft. long, with 12 furnaces. The boilers are constructed for a working pressure of 75 lbs. per square inch. The expected speed of the vessel is 14 knots, and the indicated horse power of engines, 2,400. Accommodation is provided for 60 first-class, 40 second-class, and 60 third-class passengers, besides ship's complement of Officers and men, 50 in number. On leaving the ways the vessel was named *Abd-el-Kade*, by Miss Salmon, of Perth.

George Moore.—On the 26th of May Messrs. William Hamilton & Co., launched from their shipbuilding yard at Port Glasgow an iron screw-steamer of the following dimensions:—Length, 210 ft.; breadth, 30 ft.; depth, 16 ft.; to be fitted with compound surface-condensing engines of 100-horse power nominal, and to be classed 100 A 1 at Lloyd's. This steamer has been built to the order of Messrs. John Melmore & Co., of Maryport. On leaving the ways she was named the *George Moore* by Mrs. George Partmer, wife of one of the owners.

Amy.—On the 26th May Messrs. Cunliffe & Dunlop launched at Port Glasgow a screw steam yacht for Mr. N. B. Stewart, of Wemyss Bay and Rockwood, Torquay, of the following dimensions:—Length, 167 ft.; breadth, between perpendiculars, 27 ft. 2 in.; depth moulded 17 ft.; depth of hold, 14 ft. 10 in.; tonnage, builder's measurement, 603 tons. The engines, supplied by the builders, are capable of indicating 600-horse power. The vessel is three-masted, the length of the different masts being, foremast, 100 ft.; mainmast, 109 ft; and mizen mast, 94 ft. As the vessel left the ways she was christened the *Amy* by Miss Stewart, niece of the owner.

Greyhound.—On the 27th May there was launched from the yard of Messrs. Robert Duncan & Co., Port Glasgow, a screw

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steamer, 162 by 22½ by 11; classed 100 A 1, special survey, fitted with compound engines of 60-h.p., by Messrs. Smith, Bros. & Co. This vessel is built to the order of Messrs. Robert Thomson & Co., of London.

Stanley.—On May 27th Messrs. Robert Napier & Sons launched from their shipbuilding yard at Govan a store-carrying vessel, named the *Stanley*, for her Majesty's Government. The vessel, which is 120 by 24 ft., is constructed of iron and steel, and is intended to be used in carrying guns and ammunition for the War Department. She will be supplied with direct-acting compound engines by the builders, and on being completed will be at once despatched to England to take her station on the Thames. After the usual ceremony observed on such occasions had been performed by the Rev. John Macleod, B.A., minister of Govan parish, Mrs. Kirk cut the rope which held the last of the dog shores, and named the *Stanley* as she made her way to the river.

Earn.—On May 27th there was launched from the shipbuilding yard of Messrs. James Mollison & Sons a wooden vessel of 320 tons register. Her dimensions are—length, 130 ft.; breadth, 26 ft.; depth of hold, 14 ft. 4 in. As the vessel left the ways she was gracefully christened the *Earn* by Mrs. Captain Anderson. The *Earn* has been built under special survey, and is classed A1 at Lloyd's for 12 years. She is owned by Messrs. Robertson Brothers, will be commanded by Captain Anderson, and engaged in general trade.

Adeline Schull.—On the 27th May, there was launched from the yard of Messrs. H. M'Intyre & Co., Paisley, shipbuilders, an iron screw steamer of 600 tons for trading between London and Antwerp. As the vessel left the ways she was named *Adeline Schull.*

Fanny Crossfield.—On the 27th of May a new three-masted schooner, built for Messrs. James Fisher & Sons, Barrow, was launched from Mr. Rodgers's shipbuilding-yard, Carrickfergus. Her dimensions are:—Length, 96 ft.; breadth, 22½ ft.; depth, 10 ft. Her carrying capacity will be about 200 tons. She has been built under special survey, and classed A1 at Lloyd's for 12 years. The ceremony of christening the vessel was performed by Mrs. Rodgers, who named her the *Fanny Crossfield.*

Leda.—On the 29th of May there was launched from the shipbuilding yard of Messrs. Murdoch & Murray, Port Glasgow, a steam yacht for Mr. David Laidlaw, of Chasely, Skelmorlie, of the following dimensions:—100 ft. by 14 ft. by 8 ft. 6 in. deep. As the vessel left the ways she was named *Leda* by Miss Murdoch, of Park-street East, Glasgow. The vessel was launched with boiler and engines on board. These consist of a pair of compound surface condensing engines of 30-horse power nominal, the cylinders being 13 in. and 24 in. by 18 in. stroke with working pressure of 80 lbs., and are supplied by the owner from his engine works, Alliance Foundry, Glasgow.

Courrier de Iles d'Hyeres.—On the 29th of May, Messrs. D. Allan & Co., shipbuilders, Leith, launched from their yard a screw steamer of 70 tons gross register, built to the order of M. Vaccaro, of Marseilles, intended for Government service between the naval port of Toulon and the Island of Hyeres. Her dimensions are:—Length, 88 feet; breadth, 16 feet 6 inches; depth, 8 feet 6 inches. Her engines of 25-horse power, nominal, will be supplied by Messrs. Muir & Houston, Glasgow. She was named the *Courrier des Iles d'Hyeres.*

Mustapha Ben Ismail.—On the 7th June Messrs. Scott & Co. launched from their shipbuilding-yard, Cartsdyke, Greenock, a screw-steamer, built to the order of the Compagnie Generale Transatlantique, and which is similar in all respects to the steamer *Dragut*, which the Messrs. Scott launched a fortnight ago for the same company. Her dimensions are as follows:—Length, 185 feet; breadth, 25 feet; depth, 17 feet; and 550 tons burthen. As the new vessel left the ways she was named the *Mustapha Ben Ismail.* After the launch she was towed to the East India Harbour, where her machinery will be put on board.

Boldana.—On the 7th June Messrs. Wm. Denny Brothers launched from their yard at Dumbarton, a steel screw-steamship of the following builders' dimensions, viz.:—Length, 320 feet; breadth, 40 feet; depth, 28 feet; and about 2,800 tons gross register, for the British India Steam Navigation Company (Limited). The vessel on leaving the ways was named the *Boldana* by Miss Denny Meadowbank, Dumbarton. The vessel will be fitted with compound direct-acting engines by Messrs. Denny & Co., Dumbarton.

Pharos.—On the 8th June Messrs. Aitken & Mansel launched from their yard at Whiteinch a screw steamer of about 2,300 tons register, which has been built for Messrs. James Moss & Co., of Liverpool. This vessel, which was named *Pharos* by Miss Mackintosh, of the Manse, Uddingston, is intended for the Mediterranean trade, and will be fitted with machinery by Messrs. John & James Thomson, Finnieston Foundry.

Lennox.—On the 10th June an iron screw steamer of about 2,100 tons, for Messrs. John Warrack & Co., Leith, was launched by Messrs. Alex. Stephen & Sons at Linthouse, and was named *Lennox* by Mrs. Gulland, wife of W. G. Gulland, Esq., Singapore. The *Lennox* has been built under special survey to the highest class in Lloyd's and Board of Trade requirements, and was fitted before launching with compound surface-condensing engines, having cylinders 38 in. and 68 in. diameter by 45 in. stroke, and a working pressure of 85 lbs. She is intended for the Eastern trade, and will be commanded by Captain Scott.

Diolibah.—On June 11 the *Diolibah* was launched from the yard of Messrs. A. M'Millan & Son, at Dumbarton. She has been built to the order of M. Verminick, of Marseilles, and will form one of his fleet trading from Marseilles to Senegal. The dimensions of the vessel are 265 by 36 by 25, and her tonnage about 1,800. She is classed 100 A 1 at Lloyd's. Her engines, which will be of 1,000-horse power, will be supplied by Messrs. Denny & Co.

Isaac Pereire.—On the 12th June, Messrs. John Elder & Co. launched from their shipbuilding yard and engineering works at Fairfield, Govan, the *Isaac Pereire*, a French mail and passenger steamer, for the Compagnie Générale Transatlantique. The *Isaac Pereire* is the last of the four steamers for the Company for which Messrs. Elder & Co. obtained the order in November last. The *Isaac Pereire* is exactly similar to the *Moise*, *St. Augustin*, and *Abd-el-Kader*, recently launched by Messrs. Elder & Co., and the principal dimensions of the vessel are:—Length between perpendiculars, 313 ft. 6 in.; breadth, 33 ft. 6 in.; depth moulded, 25 ft. 6 in.; gross tonnage, about 1,800 tons. The engines, which are supplied by Messrs. Elder & Co., are on the compound principle, with inverted cylinders and surface condensers. The high pressure cylinder is 42 in. diameter, and the low pressure 80 in. in diameter, the stroke being 4 ft. Steam is supplied by two circular double-ended boilers of 13 ft. 6 in. diameter, and 17 ft. long, with 12 furnaces. The boilers are constructed for a working pressure of 75 lbs. per square inch. The expected speed of the vessel is 15 knots, and the indicated horse-power of the engines 2,400. Accommodation is provided for 60 first-class, 40 second-class, and 60 third-class passengers, besides ship's complement of officers and men, 50 in number. As the vessel left the ways she was named the *Isaac Pereire* by Madame Boulouze, wife of the Vice-Consul, Glasgow.

Bellerophon.—On the 12th June Messrs. Scott & Co., shipbuilders, Cartsdyke, Greenock, launched from their yard a screw steamer, built to the order of Mr. Holt, of Liverpool. The new vessel is of the following dimensions:—Length, 321 ft.; breadth, 34 ft.; depth, 26 ft.; 2,167 tons burthen. As she left the ways she was named the *Bellerophon.* She is a sister ship to *Cyclops*, launched in April last by the Messrs. Scott. Her engines will be supplied by the Greenock Foundry Company.

Adria.—On the 12th June Messrs. Blackwood and Gordon launched at Port Glasgow a screw steamer of the following dimensions:—Length, 245 ft.; breadth of beam, 32 ft. 6 in.; depth of hold, 17 ft.; 1,300 tons. She has been fitted by the builders with compound surface-condensing engines of 130-horse power. The new steamer is named the *Adria*, and has been built to the order of the Adria Steam Shipping Company, Glasgow, of which Messrs. Burrell & Son are managing owners. The *Adria* is meant for the Adriatic and Mediterranean trades.

Southfield.—On the 12th June Messrs. Russell & Co. launched at Port Glasgow a barque of the following dimensions:—Length, 192 ft.; breadth of beam, 36 ft. 6 in.; depth of hold, 19 ft. 7 in.; 900 tons. This vessel, which has been named the *Southfield*, is built to the order of Mr. Renton, of Glasgow, and is exactly on the same lines as the *Peeblesshire*, built by Messrs. Russell & Co. She will probably proceed to Glasgow to load for Sydney.

Warkworth Husbern.—On the 12th June Messrs. J. M'Intyre & Co. launched from their shipbuilding-yard at Merksworth, Paisley, the *Warkworth Husbern*, an iron screw-steamer, 900 tons, built to the order of Mr. H. Andrews, Warkworth Husbern, Northumberland. She will be fitted with compound surface-condensing engines by Messrs. Dunsmore & Jackson, Govan. The steamer was named by Madame Gudi, wife of Cavalero D. P. Gudi, Naples

Ellas.—On the 18th June Messrs. H. M'Intyre & Co., shipbuilders, Merksworth, launched a screw-steamer, intended for passenger and goods traffic in the Archipelago. She was built to the order of Signor D. Gudi, Naples and Spezzia, and on leaving the ways was named *Ellas* by Captain Gudi, nephew of the owner, and future commander of the vessel. The *Ellas* is 160 ft. long, 12 broad, and 11 ft. 3 in. deep. Messrs. Hutson & Corbett, Kelvinhaugh, are to supply her with 80-horse power engines. She is to trade under the Greek flag, and has accommodation for 30 first and 20 second class passengers.

LAUNCH.—IRISH.

Rosetta.—On the 27th of May the first vessel which has been built in Ireland for the Peninsula and Oriental Steamship Company, was launched from the iron shipbuilding works of Messrs. Harland & Wolf, Queen's Island, Belfast. The dimensions of the vessel are:—Keel and forerake, 300 ft.; breadth of beam, 40 ft.; and depth of hold, 29 ft. Her mean registered tonnage will be 3,500. The vessel will be rigged and fitted out in Belfast. Messrs. James Howden & Co., of Glasgow, will supply the engines. As the *Rosetta* left the slips the ceremony of naming was performed by Mrs. Killock, wife of Captain Killock, who superintended the building of the vessel on the part of the Peninsular and Oriental Company.

TRIAL TRIPS.

Edith.—On 25th May the steamship *Edith*, of Hull, had a trial trip. She was a screw steamship of 584 tons gross and 276 tons nett, built in 1864 by Messrs. Hendrickson & Co., of Renfrew, and was intended for blockade running. The conclusion of the American War, however, made her useless for this particular trade, and she was then purchased by Messrs. G. Lawson & Co., of Hull, for their service between Hull and Rotterdam. In this branch of commerce she has been since engaged, but her consumption of coal, and the space occupied by her engines, rendered some improvement indispensable, besides which, the age of her boilers, and consequent deterioration, had materially reduced her rate of speed. In order to obviate these defects, her owners placed her under the charge of Earle's Shipbuilding and Engineering Company (Limited), Hull, who have strengthened and refitted her, and designed and built her a new set of engines and boilers. The vessel left the Hull Pier on the day mentioned, and proceeded down the Humber to run the measured mile off Withernsea. Four trials were made, which gave the following results—against the tide, 11·9 and 11·43 knots; with the tide, 12·7 knots and 13·84 knots, or a mean of 12·50 knots, or 14·393 miles per hour. The new engines are two pair of compound surface condensers of 120-horse power nominal, working up to 550 effective, and the consumption of coal will be reduced from 17 cwts. per hour to 8 cwts. These alterations have now made the *Edith* 562 tons gross, 315 tons nett, and enabled her to carry 70 tons more cargo. She is propelled by two screws, which work entirely independent of each other.

Anthracite (*s*).—On May 26th the *Anthracite* took a trial trip in the Thames. The *Anthracite* was built by Messrs. Schlesinger, Davis, & Co., of Wallsend, and engined by Messrs. Hawks, Crawshay & Sons, of Gateshead-on-Tyne. She is 84 ft. long, 16 ft. beam, and 10 ft. deep, her engine and boiler room being 22 ft. 6 in. long. Her gross tonnage is 70·26 tons, and her registered tonnage 27·91 tons. Her engines have three cylinders, of 8 in., 16 in., and 23 in. diameter respectively, with 15 in. stroke. They are of 20-horse power nominal and 168-horse power indicated. The high-pressure and medium cylinders are single acting. The low-pressure cylinder being double acting. The *Anthracite* was originally built for Mr. Robert M'Calmont, of the firm of M'Calmont Brothers, in order to test the Perkins system on an Atlantic voyage. His protracted illness has, however, frustrated his design, and the vessel has come into the possession of the Perkins Engine Company, who are now going to carry out Mr. M'Calmont's intention, and put the system to the extreme proof, by sending her on a voyage to New York and back, in charge of Captain Dent. A preliminary run was made with her on the 26th to the Chapman Light and back, a distance of about 46 miles. The steam pressure throughout was maintained at an average of 350 lbs. per square in., half throttled, and the revolutions at 132 per minute. Both the pressure and the number of revolutions were very steadily maintained, and the engines worked most satisfactorily. With the tide against the vessel both ways, her speed averaged eight knots hour.

The Sahara.—On the 26th May the screw steamer *Sahara*, a vessel of 3,000 tons burthen, built to the order of the Bedoum Steam Navigation Company (Limited), Liverpool, of which Messrs. W. and R. Thomson are the Managing Owners, made her trial trip over the measured mile at Whitby, when she attained an average speed of 11·28 knots, she being at the time in ballast trim. The machinery during the run worked with perfect smoothness, and the trial in all respects gave the greatest satisfaction to the owners, who were represented on the occasion by Mr. William Thomson and Mr. William Glover, the company's Inspecting Engineers, under whose superintendence the vessel and her machinery have been conducted. Immediately on her return to port the vessel went alongside the Commissioners' Spoutt at Whitehill to take a cargo for the Baltic and from thence to America.

The Chancellor.—On the 28th May the new saloon steamer *Chancellor*, built for the Lochlomond Steamboat Company by Mr. Robert Chambers, jun., Ship-builder, Dumbarton, and engined by Messrs. M. Paul & Co., engineers there, went down the Clyde on a trial trip. This vessel, which will take up the station between Helensburgh, Greenock, Dunoon, and Arrochar, connecting with the Lochlomond steamers, is 207 ft. by 21 ft. 6 in. by 8 ft. She is built entirely of steel, having a saloon running nearly the entire length and breadth of the main deck, with a continuous promenade fore and aft. The vessel is supplied with diagonal engines of about 900 indicated horse-power, having two cylinders of 36 in., with a stroke of 5 ft. The boiler, which is also of steel, is 14 ft. in diameter and 13 ft. 6 in. high. The *Chancellor* behaved most admirably. The engines worked well, and there was an absence of shaking and tremulous movement. The vessel started from Helensburgh, and then ran across to Prince's Pier; from thence she sailed to Dunoon, and then ran down as far as the Cumbrae Lights. The speed attained was 16·9 knots per hour, which was regarded as very satisfactory.

The Avlona (*s.s.*)—The steamship *Avlona*, a vessel of nearly 2,000 tons gross register, which has been built and engined by Messrs. Gourlay Brothers & Co., Dundee, to the order of Mr. W. Thomson, Euclid Crescent, ran her trial trip on May 29th. After embarking a large company of ladies and gentlemen off Camperdown Dock, the anchor was weighed, and she steamed down the river, saluting the *Lightship* in passing, and having a view of the excursion steamer *Quickstep* high and dry on the Abertay Bank. On reaching the bar the Bell Rock was steered for, and, the weather being fine, the *Avlona* was able to approach within a short distance of the lighthouse. Signals having been exchanged with the keepers, a course was shaped for the Red Head, and after nearing it the vessel was again turned in the direction of the Bell Rock. On the return journey the company sat down to luncheon. Mr. Thomson, in proposing the health of the builders, said that it was now nearly ten years since he had had steamers built by Messrs. Gourlay Brothers & Co. for the Atlantic trade, and these vessels had not only done their work without accident, but the performances of the steamers had been such as to place him in a favourable position with his competitors, and so enable him and his co-owners to participate in satisfactory results. Mr. Henry Gourlay replied on behalf of the builders in suitable terms. Mr. Thomson and Captain and Mrs. Halcrow's healths were also drunk. On the run from the Bell Rock to the Fairway Buoy a speed of 13½ knots was attained, which was considered exceedingly satisfactory. The *Avlona* was berthed in Victoria Dock with the evening tide. The London Shipping Company's steamer *Britannia*, which was leaving the docks for London at the time, was an object of admiration to those on board the *Avlona*, and her yacht-like appearance was especially commented upon. The weather during the whole trip was all that could be desired, and all enjoyed themselves thoroughly. The *Avlona* is to be engaged in the Atlantic trade.

The Malemba.—On June 2, the new steel screw-steamer *Malemba*, which has been built by Messrs. John Elder & Co., Govan, to the order of the British and African Steam Navigation Company of Glasgow, went down the Firth of Clyde on her trial trip. This steamer is a sister ship to the *Coanza*, built by Messrs. Elder for the same company, and is of the following dimensions:—Length between perpendiculars, 290 ft.; breadth, 36 ft.; depth of hold, 18 ft.; tonnage gross, 1,520 tons. This vessel is designed to have large carrying capacity, combined with light draught of water, and is for that reason entirely built of steel. The engines, which are supplied by the same firm, are on their compound principle, and, on the trial, gave a maximum speed of 12·76 knots, and an average speed of 12·56 knots, as against the contract speed of 11 knots.

The Lake Manitoba.—On the 2nd of June the new steamer, *Lake Manitoba*, belonging to the Canada Shipping Company, went on trial down the Firth of Clyde. The result was very satisfactory, the mean speed attained being 14 knots. The *Lake Manitoba* has been built by James and George Thompson, and is a sister ship to the *Lake Winnipeg* by same builders. She is 3,500 tons and 400-horse power, and is built of special strength and scantling for the Canadian cattle and produce trades.

The St. Augustin.—The trial trip of the screw steamer *St. Augustin*, built by Messrs. John Elder & Co., for the Compagnie Generale Transatlantique, took place on the 4th June. After taking a party invited by the builders on board at Greenock, the *St. Augustin* proceeded to Skelmorlie, where she ran the measured mile. On the first run the steamer accomplished the distance in 3 minutes 35 seconds, showing 16 knots, with the tide; the second, against the tide, in 4 minutes 4 seconds; the third up, in 3 minutes 48 seconds; and the last in 4 minutes 4 seconds—giving on the four trials an average speed of 15·35 knots per hour. The *St. Augustin* is one of four ships entrusted to Messrs. John Elder & Co. by the French company. Her length between perpendiculars is 313 ft. 6 in.; breadth, 33 ft. 6 in.; and depth (moulded), 25 ft., with a gross tonnage of 1,850. The engines are on the compound principle, with inverted cylinders and surface condensers, the high pressure being 42 in. diameter, and the low 80 in., with a 4 ft. stroke. At the time they worked very smoothly, the steam pressure being 75 lbs. per square in., vacuum 28 in., and the revolutions per minute 78. The contract speed is 14 knots per hour, and, as has already been stated, she did 1·35 knots above that, giving an indicated horse power of 2,563, or 463 above the contract.

The *Rio Branca* (*s*).—The new steamer *Rio Branco*, built to the order of Senor Conceiçao, director of the National Brazilian Steam Navigation Company, by Messrs. Henry Murray & Co., of Port Glasgow, has successfully gone through the trials over the measured mile. Although the weather was very unfavourable, the sea running high, and a strong wind blowing, the vessel made a speed of 11½ knots on the first trial, and on a subsequent trial 13 knots, a speed that exceeded expectations. The engines, which are of the compound steeple class, were constructed by Mr. D. Rowan, of Glasgow. The boilers and hull are of steel, and cabin accommodation has been provided for 120 first-class passengers and 200 third-class passengers. The cargo-carrying capacity is 600 tons.

Iris.—After a successful cruise of six days for the adjustment of her brasses which gave out during her measured mile trial last month, and for a continuous testing of her machinery, the quick despatch-vessel *Iris*, Capt. E. Seymour, was again placed upon the mile in Stokes Bay on June 12th, and as everything passed off with the greatest satisfaction, the trial may be regarded as final. The ship, for the purposes of the trial, was under the command of Capt. Wells, of the Portsmouth Steam Reserve, while the machinery was under the immediate superintendence of Mr. Charles Icely, who was assisted by Mr. A. Durston, of the Steam Department of the Dockyard, and Mr. Thompson, the chief engineer of the ship. The *Iris* was at her full load draught, being commissioned and ready for sea—viz., 17 ft. 8 in. forward and 21 ft. 9 in. aft. As the performances of the ship had been abundantly tested on previous occasions, the trial was limited to four full-power runs on the measured mile, the results obtained in May not having been deemed perfectly satisfactory at the Admiralty. The following were the *data*, there being little wind and the sea quite smooth:—

	Revolutions.		Observed Time	Speed in	Indicated Horse-
Runs.	Starboard.	Port.	M. S.	Knots.	power.
1	91·64	93·73	3 21	17·910	6,993·89
2	96·76	95·88	3 24	17·646	7,477·14
3	93·40	96·18	3 14	18·557	7,338·63
4	93·75	96·92	3 28	17·308	7,481·73
Means	93·88	95·67	3 23	17·977	7,347·84

The horse-power developed during the trial was thus 347·84 horses beyond the contract power, while the mean of all the means gave a speed of practically 18 knots with all weights on board, or about only half a knot less than was realized during the trials undertaken when the ship was "flying light." Indeed the substantial results have given a speed even beyond the estimate of the designers of the ship. During the first run the steam was scarcely up to the mark, but in the succeeding runs it was maintained at blowing-off pressure. There can be no question that had the first mile been discarded and a fifth run made, the result would have exhibited a speed of slightly over 18 knots. The mean pressure of steam in the boilers was 62·75 lb.; the mean vacuum in the condensers was 27·69 in. starboard and 27·62 in. port; the mean revolutions of both sets of engines were 94·77 per minute; and the mean pressures in the cylinders—starboard 42·25 lb. high, and 11·45 lb. low; port, 40·15 high, and 12·025 low. The machinery, which is by Messrs. Maudslay & Co., worked in all respects satisfactorily.

The Washington (*s*).—On the 8th of June this steamer left the Firth of Clyde for a trial of upwards of 200 miles' steaming at sea, and returned early the following morning, having made an average speed of 14·47 knots per hour over the whole run, which is considerably in excess of the speed promised by builders. As the *Washington* is a sister ship to the *Vincenzo Florio*, recently described in our columns, we need not repeat the particulars, but may merely mention that she is a vessel of about 3,000 tons, with compound engines of 370-horse power nominal, built by Messrs. Alexander Stephen & Sons, Linthouse, to highest class in Lloyd's is fitted with Emerson Walker & Co., Patent Horizontal Direct Steam Windlass, and intended for the fine fleet of Messrs. I. & V. Florio & Co., of Palermo. Captain Diliberto, who has superintended the construction of both steamers, is to take command of the *Washington*.

S.S. Garry.—On June 10th this fine vessel, built to the order of Mr. James Mitchell by Mr. W. B. Thompson, Dundee, proceeded on her trial trip. She left the dock at 4 a.m. and steamed out to sea, rounding the Bell Rock, and returning to the roadstead about half-past 9. A large party of gentlemen were then taken on board, and the *Garry* again steamed down the river. When the fairway was reached it was decided to steer for the Redhead and Lunan Bay. A splendid view of the cliffs was obtained, the vessel being quite close inshore. After firing a salute off Ethie House, the head of the *Garry* was turned for home, and in the course of the run luncheon was served. A satisfactory rate of speed, with very little vibration, was attained. The sea was calm, and with bright sunshine the excursion was greatly enjoyed. In the evening the vessel was again safely docked.

The Albert Victor.—This steamer, built for the Folkestone and Boulogne service of the South-Eastern Railway, was launched on the 10 of last month from the building yard of Messrs. Samuda Brothers, Poplar, has since received her engines from Messrs. Penn & Sons, and lately made a preliminary trial trip, when she fully realized the result she was expected to accomplish. The trial was made at the Maplin Sands, on the Government measured mile. The vessel was carrying all the outfit and weights she will have in ordinary service, and was drawing 7 ft. 10 in. of water. The speeds observed were as follows, viz.:—1st run, time, 3 min. 1 sec. equal to 19·890 knots; 2nd, 3 min. 24 sec., equal to 17·647 knots; 3rd 3 min. 5 sec. equal to 19·459 knots; 4th, 3 min. 19 sec., equal to 18·090 knots; the mean of the four runs being 18·698 knots, or 21½ statute miles. The engines developed 2,800-horse power, and maintained throughout the trials a steady steam pressure of 29 lbs. and 27 in. of vacuum, making 40 revolutions per minute, and working in all respects satisfactorily.

Garnet (*s.s.*)—This vessel, which has been built by Messrs. Gourlay, Brothers & Company, Dundee to the order of Mr. P. M. Duncan for the Baltic and Mediterranean trade, made her trial trip on June 12th. The *Garnet* is the fifth of the Gem line, and is the second steamer belonging to Dundee which has been fitted up with Higginson's patent steam quartermaster, the *Britannia* being the first. The *Garnet* left her moorings shortly after 11 o'clock, when the admirable character of the steam steering apparatus was instantly seen. It is so simple that a child might work it, and so quick and efficient, in action that it must infallibly be a great preventive of accidents. The helm, for instance, can be put "hard over" in nine seconds. The vessel proceeded down the river to the Bell Rock, and the maximum speed attained was over twelve knots an hour. At the Lightship and the Bell Rock salutes were exchanged. On the return voyage from the Rock luncheon was served to the company on board. Mr. Duncan, who presided, proposed the health of Messrs. Gourlay Brothers, and in doing so expressed his thorough satisfaction with the manner in which the vessel had been constructed and fitted out. Though a cargo boat, her deck and cabin fittings were quite equal to those of high-class passenger steamers. Mr. Gourlay thanked Mr. Duncan for his statement, and trusted that the *Garnet* would not be the last of the Gem line which his firm would build. The gross tonnage of the *Garnet* is 1,005 tons, and her nominal horse power is 100. Immediately after the trial trip the *Garnet* proceeded on her maiden voyage to Archangel, where she is to load a cargo of flax for Dundee merchants.

The Tangier.—This screw steamer, which has been built in the shipyard of Messrs. Raylton Dixon & Co., of Middlesbrough, to the order of Messrs. Angier Brothers, of London, proceeded on her trial trip from the former port on June 17. The vessel is 278 ft. long, by 35 ft. 3 in. broad, by 24 ft. 6 in. depth of hold. She has two decks laid and lower tier of beams, her maindeck being of iron, and the upper deck of wood. She has water ballast in her after hold, engine-room, and in a large chamber in fore hold; is strongly fitted with shifting boards carried down to keel, and is specially adapted for the grain trade. She is schooner rigged, and her lower masts are of iron. Her gross register is about 2,000 tons, and she will carry nearly 2,800 tons, at 22 feet draught of water. Her engines are 170 horse-power, by Messrs. Thomas Richardson & Sons, of Hartlepool, fitted with their patent steam starting gear and all their latest improvements, and is expected to do about 10 knots, as accomplished by her sister ship, *Titania*, recently turned out by her builders. The owner, Mr. Angier, Mr. Dixon, and a small party of friends accompanied her on the trial trip round to the Tyne, which was perfectly satisfactory. She will berth in the Northumberland Docks, and take on board her first cargo of coals for Alexandria.

Julia.—On the 17th June the screw steamer *Julia*, built to the order of A. C. De Freitas & Co., of Hamburg, by Messrs. S. P. Austin & Son, iron and steel shipbuilders and repairers, Sunderland, made her trial trip, leaving port at 9.30 a.m., and returning into Sunderland at 9 p.m., the same day. The machinery worked very satisfactorily, and notwithstanding that the boat was in ballast, the wind being high and the sea rather rough, she maintained an average speed of nearly 10 knots. The result of the trial was in all respects to the satisfaction of the owners.

Ville d'Oran.—On the 18th June, the screw steamer *Ville d'Oran*, built by Messrs. Wigham, Richardson & Co., Neptune Works, Low Walker, for the Compagnie Générale Transatlantique, proceeded to sea upon the first of a series of trial trips. The dimensions are:—Length between perpendiculars, 313½ ft.; breadth of beam, 33½ ft.; depth, 25¼ ft. She will obtain the highest class at Veritas, but the company's specification has provided for considerable increase of scantlings of iron to give more longitudinal strength than required by the rules. Accommodation has been provided for 60 first and 50 second-class passengers, while upon the lower deck there are quarters for about 40 third-class passengers, and about 350 soldiers. Her engines, which have also been built at the Neptune Works, are of large power, the cylinders being, high pressure, 42 inches diameter, and low pressure 83 inches; the stroke of the piston being 48 inches. With about 70 revolutions of the engines per minute, and an indicated horse-power of 1,880, a mean speed of about 14½ knots was obtained over the measured mile at Whitley. The vessel was brought back to the Tyne, and moored at Smith's buoys, North Shields.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

A RELIC OF HER MAJESTY'S SHIP "ORPHEUS."

To the Editor of the MARINE ENGINEER.

SIR,—It having been ascertained that the skeleton of a body found in New Zealand last autumn, was that of Mr. W. J. Taylor, second master of Her Majesty's ship *Orpheus*, wrecked off that coast in 1863, no doubt those who had connexions on board the vessel will be interested to know that, mainly through the instrumentality of Commander J. Bruce, of Her Majesty's ship *Cormorant*, the remains were interred with full naval honours at Auckland Cemetry, near those of his late Commodore, the Bishop of the diocese officiating; and now that the name of this ill-fated ship crops up again, after the lapse of seventeen years, I trust it will not be out of place on my part if I mention that there has been no memorial erected to those who perished in her beyond a tablet, put up in the Mariners' Chapel at Hobart Town.

Space will not permit of my giving a graphic account of the whole disaster, which happened on the 7th of February, but I may remind your readers that on a lovely afternoon, with all plain sail set, steam up, and every necessary precaution taken, the *Orpheus*, through the negligence of the man at the signal station ran ashore on the Manukau Bar, some miles from the land, and, out of a complement of 257 officers and men, little more than one-fourth were saved.

In his official report, Lieutenant Charles Hill, now deceased, the senior surviving officer, stated that "from the commencement and during the whole proceedings nothing could exceed the coolness and decision of Commodore Burnett, C.B., the commander and the officers, all in their stations, sentries on the spirit-room and storerooms; while the good feeling and steadiness of the men were beyond all praise, remaining at their posts until ordered by the Commodore to mount the rigging. Many were washed overboard in obeying orders. At daylight nothing could be seen of the ill-fated *Orpheus* but a stump of one mast, and a few ribs." And Sir George Grey, the Governor of New Zealand at the time, in his official dispatch to the Duke of Newcastle, said—"The conduct of Commodore Burnett, his officers, and men was perfectly heroic. I have never heard instances of greater courage, carelessness of self, and efforts to save the ship and others than have been detailed to me. At about 8.30 the mainmast went overboard, the other two masts following in less than 20 minutes afterwards. Those of the crew (and they were a great number) who had not been washed overboard or killed by spars and ropes were on the masts and rigging, and the poor fellows, as these went, gave three parting cheers, and then perished. I am told that not a murmur or cry was heard from the wounded and dying; and yet the manner of some of their deaths was terrible. Altogether it is one of the most affecting events that I have ever heard of, and yet one that excites admiration from the courage, self-devotion, and energetic resignation, both of the many who perished and the few who were saved."

I am fully aware that a fund was raised at the time for the relief of the widows and orphans of those who lost their lives in the execution of their duty to their Queen and country, but I trust Sir, that this brief epitome of one of the most disastrous shipwrecks that ever happened in the Royal Navy may be the means of giving the public a further chance to commemorate the loss in whatever manner is deemed best.

I may add that I have the full sanction of the Lords Commissioners of the Admiralty to endeavour to obtain subscriptions for a memorial, and that I shall be happy to receive any suggestions or communications on the subject.

Being the last survivor of the executive officers, I naturally take a warm interest in anything that concerns the ill-fated *Orpheus*, and this, sir, must be my excuse for thus troubling you.

I remain, yours, &c.,
CHAS. GEORGE BROOKE-HUNT, late Lieutenant,
Royal Navy.

[The above was omitted from June No. through want of space.—ED. M. E.]

SIMPLE AND COMPOUND ENGINES.

To the Editor of the MARINE ENGINEER.

SIR,—I have read, with great pleasure and interest, in your valuable journal, the excellent articles on "Simple and Compound Engines," which I trust will be continued, for there is a great difference of opinion which is the best style of engine for steam vessels. I think it quite possible to demonstrate, by facts, and information contributed by your various correspondents, the superiority of one class of engine over the other, and by an interchange of opinions with each other, that a wide field of knowledge can be disseminated. Before entering in detail into the consideration of the respective engines, I wish to call attention to some of the causes that affect the economy of single engines competing with compound engines made on the Wolf principle, with one cylinder on the other, or engines with cranks at right angles, having two cylinders, or three-cylinder engines, made on the Orient plan, with cranks at 120° apart. Each class of engines has its patrons, and are largely adopted by the several engineering firms. A general opinion prevails that compound engines are the most economical. By the use of large expansion, the capacity of steam engines' cylinders has been largely increased, for each horse power, as compared with the old type of engines, in which the steam entered and was exhausted from the engine at a small reduction of pressure. The great value of expansion was imperfectly understood and less valued, as I regret to add is too much so at the present time, when the users of steam power look more at the cost of the engine than to the economy of working it. The size of cylinders in single engines to compete with compound engines is necessarily much greater in proportion than formerly, when the effective pressure in the cylinder was nearly equal during the stroke, in order to work full power at a large grade of expansion; to ensure economy the cylinders must be large. The next point of importance is to thoroughly protect the cylinders from cooling, by having a casing round the cylinders, and, if practicable, to surround them with dry heat from the uptake of the boiler, by a centrifugal fan or draught-pipe, to circulate the hot air as the steam from the boiler is admitted into each cylinder; and being larger than the high-pressure cylinder of the compound engine, the area of the steam ports, and clearance of each piston bears a greater proportion to the steam used in each than the small cylinder in the compound engines, and the amount of cooling surface is likewise greater than the compound engines, which occasion extra loss of steam by condensation. The link motion and single valve are unsuitable for working the large expansion required in single engines, as the steam cannot be expanded more than 2½ or 3 times, and with steam of large pressure the full amount of work cannot be realized. The valve motion ought to affect the cut-off at one-tenth of the stroke, without wire drawing the steam; the full pressure in the boiler ought to be utilized as much as possible, for all extra pressure that cannot be so increases loss by eradition from the boiler, however well protected. In addition to wire drawing, the steam entering the cylinder, the premature opening of the exhaust-port allows the steam to escape at an early part of the stroke, when the block is worked near the centre of the link. To make the consumption of fuel approximate to compound engines, the valve must have a rapid cut off, and carry the steam on the piston till the stroke is nearly completed and the steam automatically regulated by the valve, ensuring, as near as possible, the initial pressure of the boiler in cylinder. The use of short steam ports will tend much to reduce loss, from the large proportion of clearance the steam ports bear to the steam used in each cylinder.

The great resemblance between the *Northampton* and the *Nelson*, and the equal amount of engine power in each vessel made them a fair test of the principle of single and compound engines. The vessels and engines have been built by two of our most eminent marine engineer firms. The results would, I think, have been more equal had not the disadvantages before enumerated existed in the *Northampton*, and the proportion of power from the steam separately admitted to each cylinder, bearing a less ratio to the steam used, as compared with the engine of the *Nelson*, will account for much of the increased consumption of fuel. Where the ratio of steam is small, and the effect of the steam is lessened by the diminished distance the steam acts on the piston, must necessitate a greater quantity of of steam each stroke to maintain the power of the engines.

The arrangement in the *Northampton*, having the three cylinders of equal diameter, is at variance with the economy of engines working compound, as the economy is obtained by the great difference in area of the cylinders. The pressure of steam being the same on the exhaust side of the small piston and the steam side of the large gives the advantage to the large cylinder to expand the steam economically. Had two cylinders of equal diameter been used instead of three, it would have been an useless transfer of steam to the second, and adding only the vacuum to the first cylinder. It will, I think, Mr. Editor, be obvious, the arrangement greatly reduces the economy that the compound principle obtains by difference in the diameters of the cylinders; and it will further add to the economy by diminishing the area of space between the cylinders, by using short steam ports. If the cranks in the compound engine were at a greater angle than 90° apart, it would diminish the distance the large piston has advanced in the cylinder, and reduce the loss when the communication takes place from the small cylinder. In the drawings illustrating the improved compound engines, all cylinders could be made equal sizes without diminishing the economy of the steam; the steam being transferred from the steam side of the high-pressure piston to the large cylinder; each cylinder communicating with the condenser, and dispensing with the connecting rod, will give great advantage in placing the cylinder horizontally in the vessel, especially in war steamers, where it is so necessary to protect them, by having them placed low, and a longer connexion with the crank will be gained. The angle of the rod is counteracted by admitting steam between the piston and cylinder, on the side where the angular thrust of the rod is so that the friction will be less than in any other class of engines, and the friction and great cost of lubricating motion bars be avoided; a saving of steam equal from 15 to 20 per cent. will be realized over other engines.

In a future number of your journal I propose giving a comparative calculation of the work done by equal quantities of steam in engines of equal dimensions; showing the increased economy from vacuum in each cylinder over the ordinary compound engines, when the small piston is subject to a great resistance from back pressure. A larger expansion of steam is obtained and full effect of the steam is got on each piston from the commencement of the stroke. These advantages, I think, Sir, will lead to its adoption in preference to the present form of compound engines; taking care to thoroughly protect the cylinders from loss of heat by surrounding them with heat greater than the initial temperature of steam in the boiler, and covering them with the best non-conducting substances.

Thanking you for space in your valuable journal,

I am, Sir, yours truly,

W. TURNBULL.

HEAT SCREENS FOR STOKE HOLES.

Huddersfield, June 21st, 1880.

To the Editor of the MARINE ENGINEER.

SIR,—In reference to the article on "Heat Screens for Stoke Holes" in your last issue, I think the vapour and steam arising from the water as it flows down the sheet, would prove very injurious to health, and would propose instead, to place thin sheet at a distance of one inch and a half to two inches from from the boiler, leaving proper openings for the furnace doors, etc., in it. The radiant heat from the boiler would be expended in warming the air between the boiler and screen, which could be led to the casing round the funnel, and so pass off into the atmosphere. It would be found that the hot air would not rush out at the openings for the furnace doors, but rather the cool air outside would flow in to supply the fires. The same could be applied to a series of boilers,

I remain, yours respectfully,

A. H.

Notes and Novelties.

NOVEL EQUIPMENT OF A STEAMER.—A new steamer named the *Columbia*, which has just been completed at the works of John Roach, at Chester, Pennsylvania, for the Oregon Railway and Navigation Company, has several novel and interesting appointments. Thus, the Edison electric light is adopted throughout the ship. We learn from the *Scientific American* that the lamps are 120 in number, and are supplied by four of Edison's dynamo machines in the engine-room, each line being under command of the engineer. The lights of the state rooms are under control of the steward on the outside. The state rooms on the upper and lower decks are on separate circuits, and so are the saloons. The lamp-fixtures are of the same form as those used for oil lamps, and by an ingenous contrivance they are adapted to either the electric or oil lamp, so that should the former fail in any way, the latter may be at once substituted. The electric lamp globes are frosted lightly by dipping in hydrophloric acid. The desirability of electric lighting on shipboard, where the apartments are necessarily small, is obvious. The *Columbia* has further an electric head light, consisting of a Maxim head light supplied by one of Maxim's dynamo machines placed between decks. The arc is in the focus of a parabolic reflector, by means of which a cone of light can be thrown a long distance in any direction. All the rooms are fitted up with electric calls, and the offices, smoking-room, &c., are provided with telephones, the smoking-room being in connection with the steward's room, and the captain's with the chief engineer's, purser's, and steward's. An electric tell-tale on the bridge enables the captain to tell, by simply pressing a button, whether the engine is going ahead or back, and at what speed. The steering gear has connection with the freight-hoister, but with self-acting attachment. The elevators for discharging cargo are new in design, and the running engines at the ports are arranged so that a loaded truck runs from the lower hold out to the dock entirely by steam. The arrangement of berths is similar to that in a Pullman palace car, and when the berths are not in use they are folded out of the way. The system of water-supply for fire, &c., is most complete; and a new kind of still is used which is capable of supplying 1,200 gallons of pure fresh water daily. The *Columbia* is 334 ft. in length, 38½ ft. beam, 23 ft. depth of hold, and 3,200 tons measurement. She is to ply between San Francisco and Portland, Oregon. On her way to her destination she will coal at Rio de Janerio, and there be exhibited to the Emperor Dom Pedro, who takes a great interest in the progress of electric lighting.

[illegible] Patents connected with Marine [illegible] Ship Construction, and Mechanical [illegible] in Ships, from 18th May to [illegible]

[illegible] The Marine Engineer, *by Fell and* [illegible] *23, Rood Lane, Fenchurch St., London, E.C.*

[illegible] Means for propelling small craft.
[illegible] (communicated by W. B. Reaney and [illegible]). Apparatus for elevating, transferring, [illegible] grain.
[illegible] W. [illegible] (communicated by F. A. Luckenbach). Pneumatic apparatus for elevating, transferring and distributing grain.
[illegible] W. [illegible]. Boilers, mechanical stoking apparatus, and safety valve.
[illegible] C. W. Abel (communicated by H. A. Brognard). Utilizing movement of marine or locomotive engines, for the regulation of the furnace draught.
[illegible] W. Clark (communicated by L. H. Raymond and J. Roberts). Life rafts.
2101 E. Arnaud and others. Preventing deposits or incrustations in steam and other boilers, and in cleansing such boilers.
2108 A. W. Doery (communicated by P. Murray). Steam engines and pumps.
2111 W. H. Daniels. Screw propeller.
2112 J. W. Wardle. Oscillating engines.
2122 A. Lafargue. Hydraulic steering gear.
2151 W. Chadburn. Counters, indexes, and registering apparatus for recording the revolutions of shafts.
2161 J. Hancox. Elevators for raising wheat, &c.
2173 F. W. Durham. Regulation of steam supply to engines.
2175 J. Miller. Air pumps for ventilation of ships and confined spaces, and applicable to blowing engines.
2178 W. C. Brown. Apparatus for raising vessels, &c., parts of which are applicable to other purposes.
2180 G. W. Cabjolsky. Apparatus for ascertaining the effective pressure of screw propellers.
2182 W. R. Lake (communicated by J. L. Lay). Facilitating control and operation of torpedo boats.
2225 J. Kirkman. Packing for joints.
2250 C. W. King and A. Cliff. Steam steering engines and their valve gear.
2251 A. Fildes. Apparatus for propelling vessels.
2286 H. H. Lake. Rotary steam engines.
2287 J. D. Churchill. Regulation of steam supply to engines.
2298 T. B. Heathorn. Steering and checking apparatus.
2312 W. R. Lake (communicated by C. F. Pike). Diving bells and electrical apparatus, &c., to be employed therewith for submarine or subaqueous operations.
2325 J. E. Atkinson. Stowing in or discharging torpedoes from boats, &c.
2345 H. J. Haddan (communicated by E. Mas). Engine governors.
2348 J. C. Mewburn (communicated by L. Dulac). Steam generators.
2349 J. A. and J. Hopkinson. Lubrication, chiefly of cylinders of condensing engines.
2370 J. A. Boxer. Preventing "foul hawse" and "clearing hawse."
2371 J. Needham. Breech and muzzle loading ordnance.
2375 P. Clarke. Arrangements in ships carrying grain cargoes, for better ensuring safety.
2388 J. T. Abell. Steam engine governor.
2392 D. McGregor. Mariners' compass, and appliances for adjusting and correcting same.
2405 H. E. Newton (communicated by A. Olsen). Construction of navigable vessels and means of propulsion.
2409 L. Boye. Steam engine indicators.
2413 P. Kyle. Raising sunken vessels, &c.
2416 J. S. Matheson. Marine chronometers.
2432 J. M. Sim. Ships' binnacles and lamps, &c.
2448 A. M. Clark (communicated by J. Schofield). Transmitting and accelerating motion, for propulsion of boats, vehicles, &c., &c.

⁂ *Any information regarding patents will be gladly furnished.*

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.
NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Milne, James ...	2 C	Aberdn.	Sinclair, John ...	2 C	Grnock.
Stephenson, J. T.	2 C	N Shlds.	Ramage, James	2 C	do.
Cocking, Rbt. H.	2 C	Hull.	Gow, Donald ...	2 C	Lvrpool.
Smith, James ...	1 C	do.	Houston, Walker	2 C	London.
M'Tavish, Alex.	1 C	Aberdn.	Thorpe, Wm. R.	2 C	do.
Grieve, David ...	2 C	Dundee.	Hunt, John ...	2 C	Plymth.
Durham, John ...	2 C	do.	Price, Joseph H.	1 C	S'hmtn.
Jackson, Henry	2 C	N Shlds.	Forsayth, R. W.	2 C	do.
Burdon, Wm. ...	2 C	do.	Spray, F.	2 C	Glasgow.
Singleton Thos.	2 C	do.	M'Kenzie, G. ...	2 C	do.
Adamson, I. R.	1 C	do.	Howatt, Walter	2 C	do.
M'Lean	1 C	do.	Love, Archibald	2 C	do.
Kidd, James A.	1 C	London.	Sutherland, Jas.	2 C	do.
Stewart, James	1 C	do.	Henderson, Hy.	2 C	do.
Duncan, Robt.	2 C	Lvrpool.	Todd, James ...	1 C	do.
Macaulay, John	2 C	do.	Smith, William	1 C	do.
Alexander, John	2 C	do.	Grant, William	1 C	do.
Allison, Alfd. D.	2 C	do.	Tosh, John ...	1 C	do.
M'Laren, Wm. ...	1 C	do.	Bathgate, Geo. ...	2 C	Sndrlnd.
Sayers, Robt. ...	2 C	Glasgw.	Frazer, Wm. H.	2 C	do.
Inglis, Gardiner	2 C	do.	Linsley, James ...	1 C	do.
Wright, Thos. A.	2 C	London.	Eyett, Edward J.	2 C	Lvrpool.
Morton, Thomas	2 C	do.	Fraser, John ...	2 C	do.
Brew, George ...	2 C	do.	Fairlem, Charles J.	2 C	do.
White, Archibld.	1 C	do.	Cole, Arthur ...	2 C	do.
Shearman, John	1 C	do.	Alderson Hy. M.	1 C	do.
Atkins, Ernest C.	2 C	do.	Moir, James ...	1 C	do.
Paterson, Geo. K.	2 C	Leith.	Black, William ...	1 C	do.
Kirkwood, John	2 C	do.	Partington, James	1 C	do.
M'Neilance, Alx.	2 C	do.	Kay, David W. ...	1 C	do.
Cook, Stephen H.	1 C	Hull.	Richards, T. H. ...	2 C	Shmptn.
Daglish, Wm. B.	1 C	N Shlds.	Marquand A. J.	2 C	London.
Craig, Robert ...	1 C	do.	Charles, Thomas	1 C	Bristol.
Paton, Robert ...	2 C	Dublin.	Christensen, C. C.	2 C	NShlds.
Marquand, A. J.	2 C	London.	Murray, William	2 C	do.
Johnston, J. D. ...	2 C	Grnock.	Melvin, Robert ...	2 C	do.
Howie, G. A. ...	2 C	do.	Baxter, Joseph ...	2 C	do.
Fulton, Robert ...	2 C	do.	Munro, Joseph ...	1 C	Grnock.
Hay, James ...	2 C	do.	Weir, John	1 C	NShlds.
Smellie, Jas. K.	2 C	do.	Hicks, Thos. K.	2 C	S'hmtn.
Barbour, John ...	2 C	do.	Swaffield, N. A....	1 C	do.
Anderson, Wm.	2 C	do.	Carr, Alex. G. ...	2 C	Dundee.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

POLAR EXPEDITION.—While the Swedish Government has declined to accede to the request of the Academy of Sciences and to propose to the Swedish Parliament a money vote for the establishment of a Polar station on Spitzbergen in accordance with the plan of Herr Weyprecht, and the resolutions of the International Polar Conference of October last, the Danish Government, on the other hand, has granted the funds requisite for planting a station in Upernavik, and the Russian Government has ordered the establishment of a station near the mouth of the Lena, with a branch station on one of the New Siberian Isles. On behalf of Austria, Count Wilcek has promised to defray from his own purse the expense of a station to be placed under Dr. Weyprecht's management in Nova Zembla. The United States are also participating in the measures for carrying on researches and observations in the Polar regions, the Chief Signal Service which is engaged in connection with the official meteorological department, under General A. Myer's direction, having been instructed to erect a station at Point Barrow. It is also expected that Canada will establish a station in the Arctic regions of North America. The German Government is despatching a vessel of the war navy to explore South Georgia; but with respect to the East Greenland station, the Government has, as yet, not come to any final determination. At the conference at Hamburg it was announced that the Dutch Government will provide the necessary means for an Arctic station, and at the Spitzbergen station is declined by Sweden, it is anticipated that the Dutch, the discoverers of Spitzbergen, will undertake it. Norway, also, will, it is expected, join in erecting a station in Finmark.

ROBERT WALKER'S PATENT HYDRO-CARBON FURNACE AND APPARATUS

For the Generation of Steam for Steamships and Locomotives, and for the Smelting of Ores and Metals, &c.

The following may be stated as some of the advantages secured by this valuable patent, as set out in the Report from the actual working.

1.—One ton of Hydro-carbon fuel, burned by this patent furnace and apparatus, generates as much steam as five tons of coal.
2.—One ton of coal measures (according to naval allowance) 48 cubic feet; the equivalent in Hydro-carbon only measures 17½ cubic feet. The difference, then, in favour of Hydro-carbon is 30½ cubic feet per ton, which thus becomes available for freight-paying cargo, and would be to many owners of ocean steamers, equivalent to an additional net profit at the rate of £3000 to £4000 per voyage.
3.—Economy of 70 per cent. in manual labour.
4.—Regularity of combustion and equality of temperature.
5.—Instantaneous extinction or diminution of fires in the case of need, or where required.
6.—Absence of danger of fire. The usual danger of steamships is much diminished by this process, everything being closed up, and no sparks or burning cinders being projected.
7.—Absence of loss by smoke, cinders, ashes, &c., and economy in voyage.
8.—Cleanliness, and easier and quicker voyages.
9.—The fuel can be utilized to light the ship with gas, thereby deriving an economy, obtaining more safety, and placing the control of all the lights on board ship in the hands of a proper person, viz., the Captain.
10.—The control of the fires can be in the hands of one responsible person.
11.—The existing abundance of Hydro-carbons for the purpose.
12.—The patent furnace and apparatus can be added to the existing furnaces of steamships, &c., without any alteration of the engines or boilers.

Opinions of the Scientific and Mechanical Journals.

THE INVENTORS' RECORD.—"Steam generated without smoke or dirt, and with great economy. In the patent taken out by Mr. Robert Walker, C.E., F.R.G.S., (from the reports placed before us of the actual working of the invention), we appear to have arrived at the "ne plus ultra" of perfection in the production of steam, especially for steamships. The generation of steam with coal as fuel is attended with disadvantages which have long been obvious enough. Science has endeavoured to cope with the difficulties, but with little practical result hitherto. Mr. Walker, however, has got at once to the root of the matter by dispensing entirely with the coal."

THE RAILWAY RECORD states, "We have succeeded in securing perfect combination and combustion without danger, and free from dirt. Thus having obtained the perfection of steam fuel, a minimum of labour employed, nominal space required, perfect freedom from all waste products of combustion, and consequently absence of smoke and of dirt, this invention may be regarded as the greatest discovery of the age for the comfort and convenience of ocean-going passenger steamers."

The MARINE ENGINEER.—"For steam-ships making long sea voyages the use of this species of fuel would be most important, as it makes voyages to China and Australia from England and from American ports on the Pacific coast quite easy of accomplishment, instead of being, as is the case at present, almost impossible, owing to the excessive quantity of coal which they require, and the excessive price which, in those distant seas they are obliged to pay for it. Take, for example, one of the Royal Mail Company's Steamers plying between Southampton and Central America. For the outward voyage she required to take on board at Southampton 800 tons of steam coal, costing, say, £700, and for the return voyage a further 600 tons at Jamaica, costing, say, £1,300 total, 1,400 tons costing say £2,000. The substitution of hydro-carbon fuel as burned by Mr. Walker's patent in lieu of coals, would require 200 tons to be put on board at Southampton, and 150 at Jamaica, total 350 tons of hydro-carbon fuel, costing say under £1,000. On the other hand, there would be additional space available for freight-paying cargo, on the outward voyage for 600 tons and on the homeward voyage for 450 tons; say together 1,050 tons. If this space were occupied by even the least profitable description of cargo it would be worth to the Royal Mail Company £2,000 per voyage, and the saving in wages, loading coal, wharfage time, &c., would be equivalent to a further £500, or an additional net profit at the rate of from £3,000 to £4,000 per voyage."

INDUSTRY.—"At a trifling cost an enormous degree of heat was easily attained, estimated at 5000 degrees by which iron was easily melted in ten minutes, instead of taking in ordinary circumstances two hours, and glass in two hours instead of sixteen."

IRON.—"The principle is thus of extreme simplicity, and the practical arrangements are equally so, ensuring a certainty of operation."

The EUROPEAN MAIL.—"These advantages are immense, and must eventually effect a complete revolution in our present mode of steam generation."

For prices, &c., and for terms for working this patent under royalties or licences or otherwise, apply to the patentee, Mr. R. Walker, 19, Buckingham-street, Strand, W.C.

NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

The Marine Engineer,

LONDON, AUGUST 1, 1880.

EDITORIAL NOTES.

ALL the shipbuilding world is much interested in the novel and much discussed steam yacht *Livadia* which we illustrate and fully describe in this issue. We have personally much confidence in the success of the experiment for the particular purpose desired, viz., the production of a vessel with the maximum accommodation breadth, and stability, and with the shallowest draught, whilst at the same time an excellent speed is secured. We base our confidence in the lines of the *Livadia* for speed, first on the natural facts that the turbot is one of the fastest fishes, and that all floating aquatic birds have similar lines. Secondly, it is well known that the latest racing yachts which have out done all predecessors, have peculiarly flat and extended beams, and from their great stability can carry an immense spread of canvas. Should this vessel prove as successful as we anticipate, she will be the *beau-ideal* of the steadiest gun-platform in a heavy sea. Not only on account of her steadiness and speed will she in our opinion prove a new departure in iron clads, but we think she possesses an entirely novel attribute of safety which we believe has not yet been remarked on. We have before pointed out that in the constant rivalry between heavy guns and thicker armour, the guns have still and are likely to continue to have a great supremacy. We have not yet by any means reached limit of weight or of piercing power in our guns and projectiles, whilst we are now being sorely puzzled how to add thicker armour to our already over weighted iron-clads. No serious effort has yet, however, in our opinion been made to devise an iron-clad which by its peculiar arrangement of surface should prevent the direct impact of a shot. In the case of the *Livadia* if the superstructure were removed and the turbot shaped hull alone remained rising from the water at an angle of not more than 15 or 20 degrees, we think it would be impossible for our heaviest guns to pierce such a surface even when of eight to twelve inch armour. The endeavour to strike such a floating body would, we feel convinced, result in only a ricochet of the projectile, whose force would be thus harmlessly spent. The security of such a floating battery with heavy guns mounted "en barbette" could be obtained with an exceptionally roomy and healthy superstructure above in wood for the crew, giving a construction almost identical with that of the *Livadia.*

THE Mallory propeller has just received a very satisfactory trial as applied to a service steam pinnace. Our readers will no doubt remember that the Mallory propeller is mounted on a pivoted steam post through which by suitable bevil gearing the propeller is driven from the engines fixed vertically above on a table forming part of the pivoting stem post. The whole engines and propeller are thus capable of rotating through a large arc on their own centre, and the motion thus given to the propeller is utilized to steer the vessel instead of by the rudder. The trial was made on the measured mile at Stokes Bay under the superintendence of the Steam Reserve and in the presence of the Controller of the Navy. The pinnace was constructed specially for the purpose by Mr. J. Samuel White, of East Cowes. The boiler was placed under the forecastle to balance the weight of the engines which are placed over the vertical shaft which drives the propeller. The speed attained was very fair, 8·828 knots being obtained while going ahead at 339 revolutions, and 8·451 knots when going astern with 340 revolutions. The value of the apparatus, however, consists principally in the facility with which the engines are reversed, and the remarkable steering powers that it confers upon the vessel. The engines were reversed, from full speed ahead to full speed astern in ten seconds, and the little craft could be readily turned in its own length, 42 ft. As a remarkable proof of its steering and reversing powers, the pinnace was put through the complete movements of a quadrille, advancing and retiring, and completing the figure of 8 in the ladies' chain in 37 seconds. The trial on these points was eminently satisfactory, but it was found that there was so much vibration at the stern that the after parts of boats fitted with the Mallory propeller must be strengthened.

WHEN will the Government departments learn that they are not carrying on business on their own account, to choose this or reject that at their own pleasure, but are servants in trust for the country, to do the best they can for her from whatever source economy or improvement may arise, without respect of persons. It is the Ordnance Department this time upon whose apparent stupidity, if nothing worse, we would wish to remark. We gather from the letter of Mr. W. Hope, that he and General Ripley being the inventors of a new system of breech loading gun, which they claimed would give a reduction of 80 per cent. in weight, and 60 per cent. in cost over the present Woolwich gun, with equal efficiency, made a very fair offer to the Government on the following terms: "We will make 200 breech loading guns for the Navy, showing savings of 80 per cent. in weight, and 60 per cent. in money, on General Campbell's Woolwich guns; and within those limits we will agree to any conditions of trial and proof that can be devised; and we only want to be paid if and when the War Office Officials, who are to be the judges, certify that we have fulfilled those conditions, whatever they may be." This reads like a very fair and business-like offer, in which the inventors take all the risk, and if anything like the economies in weight and cost can be effected that are claimed, the improvement is so startling as to warrant the earnest attention of the nation. What was the answer of the Government? An encouragement to the inventors to carry out the experiment at their own cost? Far from it. The answer of General Campbell seems to have been that of the proverbial Scotchman, strictly noncommittal. Before he could even "consider" such an application he required to know all the secrets of the inventors. As this would put the inventors at the mercy of the Department without any promise of business, and whose mercies are not always very tender, we do not wonder at the inventors adhering to their proposition of showing the result, as they ask no favour and take their own risk. If our Government is not cute enough to see a good business offer when they receive one, there are plenty of other Governments who will; so we do not suppose the inventors will be the losers, but rather our unfortunate country.

WE note that several new regulations as to ship lights which were passed in Council at the Isle of Wight last August will come into force on the 1st of September, 1880. These regulations apply first to sea-going steam ships under way, which are required to carry a foremast white light not less than 20 ft. above the deck, or not less than the breadth of the ship above deck. The brightness of the light is specified as to be visible at not less than five miles in a clear atmosphere. The angle of range is also specified, as also for the green starboard and red port lights, and these latter must be visible at a distance of at least two miles on a dark clear night. These particular specifications as to the brightness and exact position and angular range of the lights should serve to render all lights more regularly observable even in the thickest nights. Secondly, a distinction is now to be made between a towing steamer and other steam ships. The former must now carry two bright foremast lights as before described in a vertical line one over the other, at least three feet apart. Thirdly, an important regulation is now made for vessels whether steam or sailing, which may not be under command, for steering. This is specially applicable to vessels when employed either in laying or in picking up a telegraph cable, or which might be disabled by accident. They are required to carry three red lights on the foremast as before described in a vertical line above one another, not less than 3 feet apart, and by day to carry in place of the lanterns 3 black balls or shapes not less than 2 feet in diameter. These shapes or lights are to be taken as indicating that the vessel is not under command, and therefore cannot get out of the way. It is to be hoped that all these new regulations will reduce the number of collisions at sea, which are at present far too numerous.

* * *

A VERY interesting discovery of an old Viking vessel (probably dating back as far as 800 A.D.) has just been made in Norway. In the south-western part of Christiania Fiord is situated the bathing establishment of Sanderfiord, which is renowned as a resort for rheumatic and nervous patients. Near this place is a small village called Gogstag where there has long been a tumulus or funereal hill, known under the name of King's Hill. This mound is nearly 150 feet in diameter, gently rising to a conical apex. A mighty king, it was told, had here found his last resting place with his horses and hounds and costly treasures around him. For centuries the reverential fear of the peasantry had prevented too narrow examination, but the modern spirit of investigation has at last been too much for reverential traditions. The result of investigation has been the discovery of a complete vessel of war, a perfect Viking craft, in which the unknown hero and chieftain had been entombed with his weapons around him. This must be well worth a visit.

* * *

APROPOS to the question of the best Ordnance for the service, and the manner in which outside inventors are usually treated by the Government, we are glad to see that a move in the right direction has been made in the shape of a petition to the House of Commons supported by most influential names. This petition very clearly sets forth the immense sums of money spent by the country in manufacturing successive systems of fire-arms which are frequently already known to be obsolete, and not the best fire arm in the market. The petitioners further advance that the heads of the Government factories, who have all the rivalry of competing firms with outside inventors, are not the best advisers for the Crown on such matters, and that at any rate in times of peace a large proportion of ordnance and arms should be bought for the Government in the open market from private firms. In this we heartily concur, and for our own part think that, although Government factories and shipbuilding-yards must be tolerated as a necessary evil to meet emergencies in time of war, the country would be much better and more cheaply served if all arms, vessels, and materials were obtained in the open market by public tender, and after fair test of the respective merits of the goods submitted. This would be the way to foster the well-known ingenuity of Englishmen.

ENGELBERT'S LUBRICATOR.

A SATISFACTORY and sweet-working engine is only obtained by strict attention to details. Quite as important as attention to the brasses and cotters, is the class of lubricant used. Many a case of break-down may be traced back to heavy priming, which in turn may be traced to the peculiar action of the lubricant in the boiler. In the cases of tallow and suet they tend to cover the whole surface of the boiler, and where this is the case, the steam is prevented from rising freely, except by excessive disturbance, which tends to produce increased priming. Again, how many troubles and temporary stoppages are caused by rotted india-rubber valves, rotted packing, corroded metal, or boiler tubes bursting by weakness through corrosion, all due to the lubricant. From all these evils Messrs. Engelbert & Co. claim to have saved marine engines and boilers, and their claim is not only borne out by simple chemical facts, but is also well supported by excellent testimonials.

To produce corrosion, the lubricant must decompose and develope an acid capable of attacking metal. All lubricants that smell under heat are decomposing and volatilizing to produce that smell, and as a fact do produce a fatty acid capable of attacking metal and rotting packing and india-rubber valves.

Englebert's lubricator has been proved by chemical analysis to consist of entirely pure hydrocarbons, which are not volatile at a temperature of 600 degrees Fahrenheit, and which therefore cannot be volatilized or decomposed by any ordinary pressure of steam, as steam is not more than 300 degrees Fahrenheit at 50 lbs. above atmosphere. Being also entirely free from acid, no corrosion can possibly occur, and it tends rather to preserve than injure the packing or india-rubber valves. As the best practical evidence of its peculiar properties it is entirely free from smell under steam. This in itself is an invaluable boon for all yachts or passenger vessels, as there is nothing worse to a sensitive stomach on board ship than a whiff of oily atmosphere from the engine room. When in the boiler it has the peculiar property of collecting in globules so that the steam can rise freely between the particles. Common oils are never cheap, as in addition to their impurities a greater quantity is required to efficiently lubricate. Engelbert's lubricator, judging from the testimonials, in addition to its purity and total absence of gumming, is more efficient than tallow in lubrication, the economy amounting to as much as 30 per cent.

It is evident that a lubricator with all these advantages is well worth an immediate trial, and will eventually be generally adopted.

THE IRIS.

SINCE her return from her trial cruise in the Channel she has been fitted with a Nordenfelt machine gun, and some remarkably excellent practice was made with it at Spithead, in the presence of the Director of Naval Ordnance. It may be remembered that when this gun was tried against the Hotchkiss revolving cannon some time ago it was fired from the little *Medway* while going at only about eight knots of speed. The torpedo-boat model was thoroughly riddled and cut to pieces by 115 hits in the course of a 400 yards' run. The Admiralty, however, being desirous of ascertaining whether an attacking torpedo-boat would stand any better chance against the gun at the actual speed of a torpedo-craft, the *Iris* was ordered to make a few full power runs against the bow of the model. Starting each time with a spurt of a couple of miles, she registered a speed of 17·2 knots per hour when the firing began, and as the tide was moving at the rate of 2½ knots more, the gun really travelled at about 20 knots during the trial, or about 23 miles an hour. First run:—The *Iris* going straight at the bow of the torpedo boat, and firing from 700 yards distance until close up, 102 shots were discharged in 1 min. 9 sec. Second run:—Under like conditions, 111 shots were fired in 1 min. 10 sec. On examination the target was found to have been struck by no fewer than 110 shots out of the 213 rounds fired during the two runs. In other words, 93 shots per minute were fired, and 48 hits per minute recorded. Third run:—In this the *Iris* ran past the torpedo boat, and parellel with it, at a distance of about 200 yards, in order to represent the actual position when a torpedo craft approaches a vessel for the purpose of discharging a Whitehead torpedo. The gun, which was limited to a range of 90 degrees, fired 58 rounds in the 22 seconds during which the target remained within the range that was agreed upon. The number of hits was 38, thus giving a result of 158 shots and 104 hits per minute. Fourth run:—A first-class torpedo boat was got under steam and driven past the *Iris* at the rate of 18 knots, the two vessels thus passing one another 200 yards apart at a speed of over 40 miles an hour. The gun was again fixed at the limited range of 90 degrees, but, as the torpedo boat was manned, dummy cartridges could only be used, so that the number of hits could not be actually ascertained. But as 40 rounds were fired in the 15 seconds during which the torpedo craft was within range, it is certain that the boat would have been disabled with shot. These experiments show that excessive speed does not necessarily interfere with the efficiency of the gun, and that, considering the very short time which is given for defence against the attack of torpedo boats, it is absolutely essential that our ships of war should be provided with such rapid-firing volley guns as the Nordenfelt, which has now been adopted in the service.

LIVERPOOL DOCKS.—The Mersey Docks Board have been engaged for some years in constructing an extensive range of new docks at the north end of Liverpool, specially adapted for the accommodation of steam vessels of modern design. The docks have a great depth of water and wide entrances. They are comparatively narrow in their water space, but of great length, the intention being to range the vessels in single file along the quays, and to allow of their rapid discharge of cargo on the broad quays by which the docks are surrounded. One of these new docks, called the Langton Dock, was opened for use last week without public ceremony, and so also were the several railway goods stations which have been established in the immediate vicinity for the special use of the *Atlantic trade.*

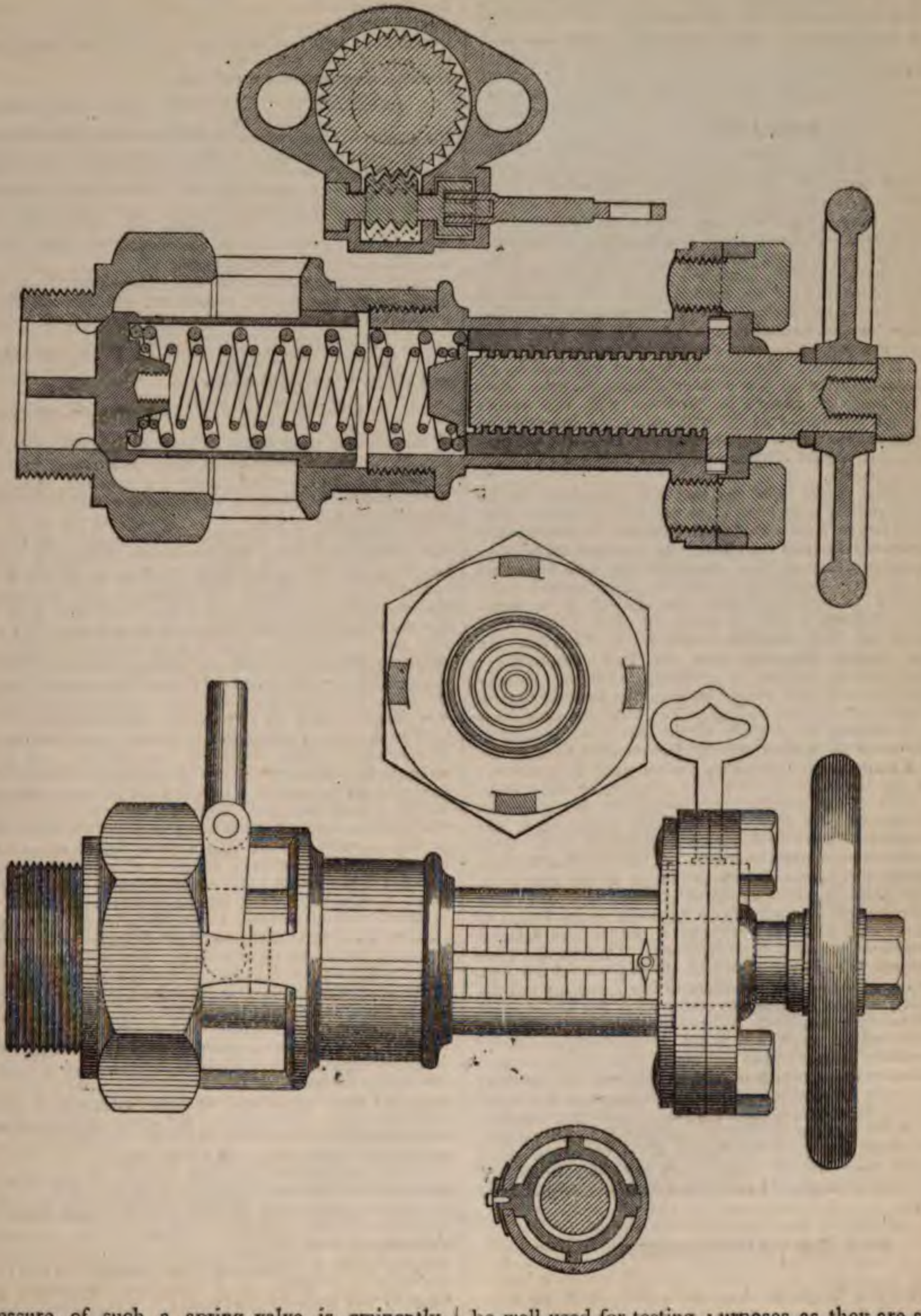
LOCK-SPRING ADJUSTABLE SAFETY VALVE.

THE greatest danger to all boilers consists of a liability to accidental explosion from over pressure. This over pressure may most easily arise from either accidental sticking of the safety valves or perhaps wilful tampering with them. The accidental sticking of a safety valve from jamming or corrosion is much more frequent than is generally supposed. A careful engineer does not frequently allow his boiler to blow off, and in that way more or less corrosion may have set in without the knowledge of the engineer. Dead weight valves with a heavy load are more likely to jam or stick by corrosion than spring valves, although the Board of Trade has been so long in favour of the former. The best protection against the danger of either sticking or wilfully weighted valves is in the shape of a safety lock-up valve, which will always blow off at the pressure for which it is set, and which cannot be tampered with by the engineer. Such a valve is that patented by Mr. J. W. Jones, of 14, Dunford Road East, Holloway, N., which we illustrate herewith. The valve is seated on the usual cone seating, and carries above it a cylindrical chamber, which contains two spiral springs. The springs are thereby enclosed and protected from the steam. The springs are adjustable as to tension by a cylindrical slide, which can be set to any position by an internal screw thread, operated by the outside handle. The exact tension or blowing off pressure of the valve is indicated by a pointer outside on a graduated scale. The escape of steam is so arranged through the outside apertures above the valve, that it could not possibly come in contact with the working parts.

The lock is a most important part of such a valve, and in this case it is most ingeniously arranged. The rotating spindle has a series of serrated teeth, into which a toothed eccentric cam engages. This cam is turned by the key so that, although in one position the serrated spindle can turn and pass the cam freely, in another position the cam gears into the teeth of the spindle wheel so that it can no longer rotate, and is thus firmly locked. The key also can only be withdrawn when the spindle is locked, so that it cannot be inadvertently removed whilst the valve is unlocked, and the holder of the key, when it is removed, has the sole control of the adjusting apparatus.

This lock is one of the neatest contrivances for the purpose that we have seen, and certainly seems to ensure absolute security, and precludes any possible tampering with the adjustment. The double spring ought to give greater elasticity of movement and regularity of pressure.

LOCK-SPRING ADJUSTABLE SAFETY VALVE.



The pressure of such a spring valve is eminently suited to marine boilers for ensuring accuracy, as it cannot be affected by the roll of the ship, as would be the case with dead weight valves. These valves might also be well used for testing purposes as they are so readily adjusted to any required pressure and are so accurate in their indication of pressure. The valve is very neat in design and presents a handsome appearance.

THE BACCHANTE.

ON July 12th and 13th the *Bacchante*, Captain Lord Charles Scott, made a trial of her machinery alongside the jetty at Portsmouth, under the superintendence of Mr. John Oliver, from the Admiralty, and the engineer officers belonging to the Steam Reserve and the Dockyard. The circumstances were somewhat peculiar. It was found during the recent cruise with the Princes Edward and George of Wales that on several occasions the engines had not moved after the order had been given, and in one instance, while the ship was in a critical position in the West Indies, as many as nine minutes elapsed before a start could be obtained. The captain reported the circumstances to the Admiralty, and the dockyard officers at Portsmouth were ordered to hold an inquiry. They discovered that both the low-pressure pistons had worked down, that the tongue-piece of the metallic packing rings had set fast, and thus been prevented from expanding, whereby the pistons were rendered leaky, and also that the packing of the working barrel of the low-pressure cylinders was defective. These defects having been remedied, steam was got up on Monday and the stopping and starting of the engines tried. The machinery was found to be under perfect control, 30 seconds being the *maximum* time required to make a move. On the 13th inst., one length of shafting was moved through an angle of 45 deg., and another trial made. The engines worked satisfactorily in these circumstances; but as the makers, Messrs. Rennie, think that a better balanced motion is produced with the cranks in their original position—that is, with both the low-pressure cranks at right-angles to the high-pressure cranks—it is not probable that the Government officials will make a permanent alteration in the arrangement.

The supersession of the chief engineer of the Bacchante by the Lords of the Admiralty is an event of so unusual a character that it has naturally formed a subject of much comment at Portsmouth, and an impression exists that the officer, who has been 26 years in the service (nine of which as chief engineer), has been somewhat harshly treated. It is stated that he was not permitted to see the report on which he was superseded, nor allowed to be heard in his own defence. The wearing of the pistons and the collapsing of the metallic rings, it is asserted, are matters for which no one can be held responsible; and in the *Rover*, which is similarly engined, it was once found necessary to place wedges between the packing rings to keep them apart and prevent leakage. The difficulty which was experienced in starting the engines of the *Bacchante* is said to have been due more to leaking cylinder jackets than to defective pistons, and it is represented that, owing to the want of appliances on board, it was impossible for the chief engineer to have ascertained the state of the jackets, and that, from the particular character of the service in which the ship was employed, it was equally impossible for him to institute an examination of the large parts of the machinery during the cruise. It appears that the high pressure cylinder was opened up on the return of the *Bacchante* from the West Indies, but that, as she was ordered off to Holyhead to take part in the opening ceremony of the docks by the Prince of Wales, the examination of the low pressure pistons was deferred until the return of the ship to Portsmouth. On two occasions during the voyage to and from Holyhead the engines did not start readily, the causes being the condition of the jacketting and the fact that, owing to want of time, the true state of the low-pressure pistons could not be ascertained. When the whole of the cylinders were eventually opened up, it was found by the dockyard officers that all the cylinder jackets leaked very much, that the low-pressure cylinders had worn down 1-16th of an inch, and not one-eighth as represented to the Admiralty, and that, in consequence of the use of unsuitable oil, the ends of the packing pieces were close together, and that the piston springs did not act sufficiently on the packing rings to keep them out upon the surface of the cylinders. It is contended that these defects would have been discovered and remedied by the chief engineer had the *Bacchante* not been ordered to Holyhead.

BOILER EXPERIMENTS.

III.

By Chief Engineer ISHERWOOD, U.S. Navy.

(From *The Journal of the Franklin Institute.*)

RESULTS.

IF the atmospheric conditions governing the force of the draught could be considered constant during the experiments, *then* the rate of combustion of the gasifiable portion of the anthracite was reduced, comparing experiments first and second $\left(\frac{4148-3625 \times 100}{4148}=\right)$ 12·61 per centum for a reduction of 21·43 per centum in the calorimeter through the tubes; that is to say, for a reduction from the proportion of 1·0000 square foot of calorimeter to 9·2443 square feet of grate, to the proportion of 1·0000 to 11·2255: all of the calorimeter in both cases being above the top of the bridge wall. Under these circumstances, the absolute vaporization was reduced

$$\left(\frac{36744{\cdot}067-31919{\cdot}145 \times 100}{36744{\cdot}067}=\right) \text{ 13·13 per centum,}$$

the economic vaporization remaining sensibly unaffected notwithstanding the reduction of 13·75 per centum in the heating surface. But had the absolute vaporizations been made the same in both experiments, by a proper reduction in the rate of combustion during the first experiment, the economic vaporization would certainly have been at least 6 or 7 per centum better in that experiment with all the tubes in use, than in the second experiment with a considerable portion of them plugged.

In the third experiment, the rate of combustion was sensibly the same as in the second experiment, but the absolute and the economic vaporizations were less. The first fell off

$$\left(\frac{31919{\cdot}145-30103{\cdot}678 \times 100}{31919{\cdot}145}=\right) \text{ 5·69 per centum.}$$

and the last, correspondingly,

$$\left(\frac{10{\cdot}202-9{\cdot}680 \times 100}{10{\cdot}202}=\right) \text{ 5·12 per centum.}$$

If the absolute vaporization in the third experiment had, by means of a higher rate of combustion, been made equal to the absolute vaporization in the second experiment, then this difference of 5·12 per centum in the economic vaporization would have been considerably increased.

With regard to the temperature of the gases of combustion in the uptake during the different experiments, and comparing the first and second experiments, there is a difference of (867·5 —814·2 =) 53·3 degrees Fahrenheit in that temperature. The rate of combustion in the second experiment was 12·61 per centum less than in the first, but the heating surface was 13·75 per centum less also. Comparing, now, that temperature in the second and third experiments, in which the heating surface and the calorimeter were exactly the same, and the rate of combustion almost exactly the same, the temperature of the gases of combustion in the uptake was (814·2—785·0 =) 29·2 degrees Fahrenheit less in the third than in the second experiment, although 15·94 per centum of the heating surface in the former was less efficient than in the latter, owing to its position below the top of the grate bars. The effect of lessening the calorimeter is to lessen the air supply proportionally to weight of coal consumed, and it may easily be lessened to an extent that will materially affect the completeness of the combustion. Now, as the quantity of heat from a given weight of coal and, consequently, the temperature of the gases of combustion produced, are lessened in proportion to the incompleteness of the combustion, too small a calorimeter may simultaneously cause both a lessened economic vaporization and a lower temperature of the gases of combustion in the uptake, although, generally, the latter would indicate a greater economic vaporization. The calorimeter through the tubes, which was small in the first experiment, being only the $\frac{1}{9\cdot2443}$ of the grate, was reduced in the second experiment to the $\frac{1}{11\cdot2255}$ of the grate, and if only that portion of the calorimeter which is above the top of the bridge wall is effective, it was still further reduced in the third experiment to the $\frac{1}{14\cdot2857}$ of the grate. Each of these reductions was probably attended by a more and more incomplete oxidation of the constituents of the coal, owing to a more and more insufficient air supply relatively to the weight of coal consumed. Thus the less and less temperatures of the gases of combustion in the second and third experiments may have been due solely to their very small calorimeters.

These results show that, with a boiler of this type and of the proportions in the first experiment, both the absolute and economic vaporizaiions are injuriously affected to a marked degree by a reduction in the heating surface of 13·75 per centum, accompanied by a reduction of 21·43 per centum in the calorimeter through the tubes, the proportion of the original heating surface to the grate surface (23·8750 to 1·0000), and of the original calorimeter through the tubes to the grate surface (1·0000 to 9·2443), being so small that further reductions in either are attended by lessened results. Also, that, other things being equal, both the absolute and economic vaporizations are injuriously affected, and to a marked degree, by placing any considerable portion of the heating surface, and of the calorimeter through the tubes, below the level of the top of the bridge-wall.

BOILER EXPERIMENTS.

By Chief Engineer ISHERWOOD, U. S. Navy.

Table containing the Data and Results of three Experiments made on a Single Furnace Cylindrical Marine Boiler at the Washington Navy-yard, by Chief Engineers LORING and BAKER, U. S. Navy, with Anthracite consumed at the Maximum Rate of Combustion, to ascertain the effect produced on the Economical and Potential Vaporization by plugging at both ends, first, the upper row of tubes (21 tubes), leaving all the other tubes in use; and then plugging at both ends the lower 21 tubes, leaving all the other tubes in use, the upper row having been unplugged. Grate surface, 24 square feet. Height of chimney above grate surface, 59½ feet.

			All the tubes in use.	*The lower 21 tubes plugged at both ends; all the other tubes in use.*	*The upper row of tubes (21 in number) plugged at both ends; all the other tubes in use.*
		Date of Experiment ...	24th May, 1873.	21st May, 1873.	23rd May, 1873.
BOILER.		Number of square feet of heating surface in use ...	573·0000	494·2228	414·2228
		Number of square feet of heating surface in use, per square foot of grate surface ...	23·8750	20·5926	20·5926
		Number of square feet of cross area for draught above the bridge wall ...	6·0945	6·0945	6·0945
		Number of square feet of grate surface per square foot of cross area above the bridge-wall ...	3·9380	3·9380	3·9380
		Number of square feet of cross area for draught through the ferrules of the tubes ...	2·5962	2·1380	2·1380
		Number of square feet of grate surface per square foot of cross area through the ferrules ...	9·2443	11·2255	11·2255
TOTAL QUANTITIES.		Duration of experiment, in consecutive hours ...	12·	12·	12·
		Number of cubic feet of water vaporized according to tank measurement ...	575·247	495·060	468·101
		Number of pounds of water vaporized according to tank measurement ...	35862·000	30858·000	29190·000
		Number of pounds of water that would have been vaporized had the difference between the quantities of heat radiated from the boiler when naked and when clad with 1½ inches thick felt been so utilized ...	882·067	1061·145	913·678
		Total number of cubic feet of water vaporized in the felt-clad boiler ...	589·306	512·084	482·846
		Total number of pounds of water vaporized in the felt-clad boiler ...	36744·067	31919·145	30103·678
		Total number of pounds of anthracite consumed ...	4568·	4050·	4098·
		Total number of pounds of refuse from the anthracite in ash, clinker and soot ...	420·	425·	485·
		Total number of pounds of combustible or gasifiable portion of the anthracite consumed ...	4148·	3625·	3612·
		Per centum of the anthracite in refuse of ash, clinker, and soot ...	9·194	10·494	11·859
RATE OF COMBUSTION.		Pounds of anthracite consumed per hour ...	380·667	337·500	341·500
		Pounds of combustible consumed per hour ...	345·667	302·083	301·000
		Pounds of anthracite consumed per hour per square foot of grate surface ...	15·861	14·062	14·229
		Pounds of combustible consumed per hour per square foot of grate surface ...	14·402	12·587	12·542
		Pounds of anthracite consumed per hour per square foot of heating surface ...	0·664	0·683	0·691
		Pounds of combustile consumed per hour per square foot of heating surface ...	0·605	0·611	0·609
PRESSURES.		Height of the barometer in inches of mercury, corrected for temperature ...	29·40	30·04	29·48
		Steam pressure in boiler in pounds per square inch above zero ...	14·60	15·00	14·73
TEMPERATURES.		Temperature in degrees Fahrenheit of the air in the boiler-room ...	81·4	57·1	77·4
		Temperature in degrees Fahrenheit of the feed-water ...	58·0	60·0	57·0
		Temperature in degrees Fahrenheit of the gases of combustion in the boiler-uptake ...	867·5	814·2	785·0
VAPORIZATION.	*Absolute.*	Total number of pounds of water that would have been vaporized in the felted boiler had the temperature of the feed-water been 100 degrees Fahrenheit, and had it been vaporized under the standard pressure of 29·92 inches of mercury ...	38173·352	33114·130	31306.454
		Total number of pounds of water that would have been vaporized in the felted boiler had the temperature of the feed-water been 212 degrees Fahrenheit, and had it been vaporized under the standard pressure of 29·92 inches of mercury ...	42633·551	36983·206	34964·320
	Economic	Pounds of water vaporized from 100 degrees Fahrenheit by one pound of anthracite ...	8·357	8·176	7·639
		Pounds of water vaporized from 100 degrees Fahrenheit by one pound of combustible ...	9·203	9·135	8·667
		Pounds of water vaporized from 212 degrees Fahrenheit by one pound of anthracite ...	9·333	9·132	8·532
		Pounds of water vaporized from 212 degrees Fahrenheit by one pound of combustible ...	10·278	10·202	9·080

STEEL IN THE SHIPBUILDING YARD.

II.

By WILLIAM DENNY, Esq., Member of Council.

[Read at the Twenty-first Session of the Institution of Naval Architects, 19th March, 1880.]

OUR practice commenced by making the stems of all the sea-going steel steamers we built of scrap steel. At the same time we made the stems, stern-posts, and rudders of all our light-draught steamers of the same material; and as success followed each fresh attempt we pushed further on, till now all three of the sea-going steel steamers we have on the stocks are to have all their forgings, stems, stern frames and rudders of the same material. We have now in place one of these stern frames weighing 9 tons. Before, however, going this length, we thought it prudent to carry out some experiments upon the material, comparing it with ordinary iron scrap forgings. The results are before you in Tables VI. and VII. For the purposes of comparison, two blooms were forged out of common scrap-iron, and two out of scrap-steel, and both worked down under the hammer into flat slabs resembling plates about ¾ in. thick. From each of these, three pieces were cut for tensile tests and two for deflection tests. You will notice that in the tensile tests the scrap-steel shows a mean tensile strength of 23·8 tons, and a mean extension of 19·5 per cent. against 20·6 tons, and 14·9 per cent. of extension in the iron plates, a decided gain, although not so decided as the difference between an original steel and iron plate. The individual tests also agree better together in the steel than in the iron scrap forgings. Under deflection we have, at 5,000 lbs. strain, the iron with a mean deflection of fully 50 per cent. more than the steel, and at 8,000 lbs. with about one-third more. These results point to the very considerable superiority of forgings made from steel scrap over those made from iron scrap. Our forge people report no failures in the manipulation of the scrap-steel. The men complain that it is tougher to work, but beyond this we have no complaint, and we have not as yet had to reject any of the forgings, or to find fault with them. A steamer we lately built for New Zealand, having engines of 1,600 indicated horse-power, had both piston-roads of scrap-steel. They worked most satisfactorily, and the ship is now running on her regular service.

Last year my partner, Mr. Brock, had occasion to have some experiments on rivetted joints made by Mr. Kirkaldy. These joints were formed of steel plates, and riveted with steel rivets. In four cases complete shearing of the rivets took place, and these cases showed successively 19·4, 20·6, 19·2, and 19·8 tons shearing strength per square inch of rivet area, or a mean of roughly 20 tons. As the rivet bars from which these rivets were made had a tensile strength of 28·9 tons per square inch, this result not only astonished but rather disquieted us, and led us in *our* ship work to treble-rivet all our skin butts in the steel ships we were building for half the length amidships, completing all the rows, so as to bring the strength of rivet area up to the strength of the most heavily punched part of the plate. The result was certainly widely divergent from that assumed to occur in iron where the shearing and tensile strength per square inch of area are supposed to be identical. We, therefore, commenced a double set of experiments, all with drilled rivet holes, and included in them, besides the comparison of iron and steel rivets, a further comparison as between hydraulic and hand-riveting, and as between scrap and homogeneous steel rivets. We also added to these a set of experiments on the effect of taking the sharp corner off the cutting edges of the rivet holes, to see whether this expedient would increase the shearing strength of the rivets. The results are shown in Tables VIII. and IX., and a combination of the two sets of tests in Table X. Regarding these, it may be remarked, that the hand-riveting shows much less regularity than the hydraulic, and is, on the whole, inferior to it. If we judge purely from the hydraulic riveting, we may assume that the scrap-steel rivets have about 21 per cent. more shearing strength than iron rivets, and that the homogeneous steel rivets have about 5½ per cent. more shearing strength than the scrap-steel rivets. The difference between the scrap and homogeneous steel is slight. Between the scrap-steel rivets and the iron ones 21 per cent. of a difference should, however, be sufficient to recommend the former, or rivets of homogeneous steel. If any action of a galvanic nature is set up between the steel plates and iron rivets, as has been suspected, a further reason for preference may be advanced. It may be asked why the steel rivets in Mr. Kirkaldy's tests sheared at a mean of nearly 20 tons per square inch, and those in the experiments now described at say 24½ tons. In the rivets tested by Mr. Kirkaldy the diameter was 1·13 inches, while in the rivets tested by us the diameter was ·82 inches, and it is possible the smaller size of rivet may, area for area, be better able to resist a shearing strain. It is also possible that shearing a single rivet may show more favourably than shearing a number. The blunting of the edges of the holes seems to have brought the hydraulic riveting up from 23·3 to 24·3 tons, and the hand riveting from 21·6 to 24·3 tons shearing strain. Taking a fair view of the matter, I do not think it would be prudent to assume in ship riveting—which must in the most important part, the skin, be done by hand—a higher shearing strain than 22 tons per square inch of area, against say 19 tons for an iron rivet. Granting this, it would seem that a full reconsideration of the subject of riveting in steel is called for; and we should recognize that the same rules can hardly apply to a material which has a shearing strength of 22 tons, against a tensile strength of 29 tons, as apply to a material having the one 19 and the other 20 tons. We shall require proportionately more riveting in steel than in iron, and in the butts especially. For half the length amidships, I think, in any steel steamer of over 300 feet long, treble chain riveted butts would be a prudent precaution from bilge to gunwale. Such riveting would also have a strong tendency to steady the butts of such thin material against local panting. The butt straps also should be made considerably thicker than the plates on this account.

One of the most important points in connection with steel is to get at some idea of the mean strength and elongation obtained in it under a given set of test conditions. To illustrate this there are shown in Table XI. the mean breaking strains of angles and bulbs, and plates, separately, as deduced from all the tests made (excluding rejections), for the four sea-going steamers we have built of steel to Lloyd's class. There is also shown the mean per-centages of extension for each. Lloyd's conditions are that the tensile strength must not fall below 27 tons, nor exceed 31 tons per square inch, and that the per-centage of extension on 8 inches must not fall below 20 per cent. The mean of Lloyd's limits of tensile strength is 29 tons, and, if you will look on the Tables before you, you will find only one instance in which the mean tensile strength of the plates falls below this, and only slightly. The angles and bulbs fall below the mean in two out of the four ships. The extensions are wonderfully even and good. Taking the mean tensile strength all over, it stands at about 29·137 tons, with a mean extension of 22·65 per cent. As a result in attempting to meet a given set of conditions, and to meet them at the same time safely and well, I think this worthy of a ready commendation; and the Steel Company of Scotland, the makers of all the steel used in these four steamers, certainly deserve credit for their success.

Looked at, however, from a constructor's point of view, I am not so contented with the result. It would be rash to assume as a factor in our calculations for strains, from the results now laid before you, a higher tensile strength than 28 tons per square inch, and we must always remember that the annealed plates will probably drop from 2 to 2½ tons lower. In the face of this contingency I think Lloyd's have been only prudent in restricting the reduction of scantlings to an overhead of 20 per cent.

But is it necessary we should restrict ourselves to such very mild steel? I think not. Till very lately my firm did so, but our last contract for steel for a large light-draught steamer had limits of tensile strength from 29 to 33 tons, and we only required an extension on 8 inches of 18 per cent. This increased strength in the steel will greatly help the rigidity of the steamer, and will not, I believe, be accompanied by any troublesome consequences.

I believe it has been too readily assumed that steel of high tensile strength is unsuitable for shipbuilding. Anyway, unless we can work it, we shall never reap the full benefit steel can confer. Would it not be possible, perhaps, while making the shell plates of a softer material as being more liable to collision, to make all the inner plating and framing of a harder and more rigid steel? Something might in any case be done in raising the lower limit of tensile strength. The results put before you as to the test averages clearly show that the steelmakers can work to close margins, and might be induced to work closer still.

So far the development in mild steel has been in the direction of a steady rise of strength. The Admiralty, who took the lead in the matter, and who deserve the thanks of the country for their efforts and success in improving the manufacture, adopted 26 and 30 tons as limits. Lloyd's, following them, adopted 27 and 31 tons, and the Liverpool Underwriters 28 and 32 tons. I have no doubt further progress will be made in this direction, but it is possibly fortunate that we have advanced no further, seeing that we have yet to decide how we are going to butt, strap, and rivet such strong material. Till we settle this point satisfactorily we are as well to delay.

TABLE II.

Results of Experiments on Six similar Samples cut from the same Steel Plates. Tested at different Speeds.

	Marks.	Dimensions.	Area.	Breaking Strain.		Elongation on 8 inches.	Elongation per Cent.	Time.
		Inches.	Sq. In.	Actual.	Per Sq. In.			
Fast	No. 1.	1·62 × ·50	·810	23·30	28·7	2·03	25·3	1′ 15″
Fast	„ 4.	1·61 × ·50	·805	23·83	29·6	1·75	21·8	1′ 46″
				Means ...	29·15	...	23·55	1′ 30″
Medium ...	No. 2.	1·614 × ·495	·798	22·81	28·5	1·87	23·4	3′ 54″
Medium ...	„ 5.	1·615 × ·50	·807	23·25	28·8	1·90	23·7	5′ 32″
				Means ...	28·65	...	23·55	4′ 43″
Slow	No. 3.	1·608 × ·50	·804	22·90	28·4	1·82	22·7	13′ 47″
Slow	„ 6.	1·61 × ·50	·805	23·70	29·4	1·82	22·7	12′ 35″
				Means ...	28·9	...	22·7	13′ 11″

Regarding the future of steel, it seems to me that there are four matters of doubt and difficulty. The first of these has been already referred to, and is the poor delivery of material as yet attained by the various steel works. This is a matter which may be expected to mend with time and practice, but up to the present it has been by no means the least serious obstacle to an enlarged use of steel.

The second matter is the aggravation of these bad deliveries by the practice of testing adopted by Lloyd's for shipbuilding material. This practice consists in testing in the yard after delivery of the material, and has been the source of exceeding annoyance, expense, and delay to builders using steel and classing at Lloyd's. It is condemned by the practice of our own and the French Admiralties, by the practice of the Liverpool Underwriters' Registry, and by the practice of Lloyd's Registry, in so far as boiler plates are concerned. It is also, I believe, condemned by every builder who has had the misfortune to suffer from it. Permit me to point out as shortly as possible the main objections to testing in the yards.

TABLE III.—Annealing Experiments.

Results of Experiments on Eight Specimens, cut from the same Hard Steel *Plate, to ascertain the Effect of Annealing.*

	Marks.	Dimensions.	Area.	Breaking Strain.		Elongation on 8 Inches.	
		Inches.	Sq. Ins.	Actual.	Per Sq. In.	Inches.	Per Cent.
				Tons.	Tons.		
Unannealed ...	No. 2	1·71 × ·25	·427	14·16	33·1	1·37	17·1
Ditto ...	„ 4	1·71 × ·25	·427	14·06	32·9	1·35	16·8
Ditto ...	„ 6	1·71 × ·25	·427	14·06	32·9	1·37	17·1
Ditto ...	„ 8	1·71 × ·25	·427	14·12	33·0	1·25	15·6
				Means ...	32·97		16·65
Annealed ...	No. 1	1·71 × ·25	·427	12·11	28·3	2·08	26·0
Ditto ...	„ 3	1·71 × ·25	·427	12·32	28·8	1·97	24·6
Ditto ...	„ 5	1·71 × ·25	·427	12·29	28·7	1·75	21·8
Ditto ...	„ 7	1·71 × ·25	·427	12·12	28·3	1·93	24·1
				Means ...	28·52		24·12

POSITION OF SAMPLES IN PLATE.

No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Annealed		Annealed		Annealed		Annealed	

Duplicate samples of above were bent cold, to a curve with a diameter equal to the thickness of the plate. All showed cracks, without any perceptible difference between the annealed and unannealed samples.

TABLE IV.—ANNEALING EXPERIMENTS.

Results of Experiments on Eight Specimens, cut from the same SOFT STEEL *Plate, to ascertain the effect of Annealing.*

	Marks.	Dimensions.	Area.	Breaking Strain.		Elongation on 8 Inches.	
		Inches.	Sq. Ins.	Actual.	Per Sq. In.	Inches.	Per Cent.
				Tons.	Tons.		
Unannealed ...	No. 2	1·663 × ·237	·394	10·60	26·9	1·90	23·7
Ditto	„ 4	1·675 × ·240	·402	10·60	26·3	1·77	22·1
Ditto	„ 6	1·680 × ·241	·404	10·82	26·7	1·94	24·2
Ditto	„ 8	1·680 × ·241	·404	10·71	26·5	2·19	27·3
				Means...	26·60		24·32
Annealed ...	No. 1	1·690 × ·234	·395	9·39	23·7	2·32	29·0
Ditto	„ 3	1·650 × 2·40	·396	9·48	23·9	2·52	31·5
Ditto	„ 5	1·660 × ·240	·400	9·79	24·4	2·31	28·8
Ditto	„ 7	1·656 × ·242	·400	9·70	24·2	2·42	30·2
				Means...	24·05		29·87

POSITION OF SAMPLES IN PLATE.

No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Annealed		Annealed		Annealed		Annealed	

Duplicate samples of above were folded close cold, Nos. 2 and 4 (unannealed) and Nos. 1 and 3 (annealed) having been previously tempered by heating to redness and cooling in water at 82° F. All the samples stood the test except Nos. 4 and 8, both of which showed cracks.

TABLE V.—ANNEALING EXPERIMENTS.

Results of Experiments on Eight Specimens, cut from the same STEEL *Plate, to ascertain the Effect of Annealing.*

(Four Samples were annealed and four unannealed.)

	Marks.	Dimensions.	Area.	Breaking Strain.		Elongation on 8 ins.	
		Inches.	Sq. Ins.	Actual.	Per Sq. In.	Inches.	Per Cent.
				Tons.	Tons.		
Unannealed ...	No. 2	1·486 × ·525	·780	22·49	28·8	2·03	25·3
Ditto	„ 4	1·490 × ·524	·780	22·36	28·6	2·05	25·6
Ditto	„ 6	1·500 × ·527	·790	22·63	28·6	2·06	25·7
Ditto	„ 8	1·510 × ·530	·800	22·58	28·2	1·90	23·7
				Means...	28·55		25·07
Annealed ...	No. 1	1·480 × ·525	·777	20·98	27·0	2·21	27·6
Ditto	„ 3	1·486 × ·525	·780	21·24	27·2	2·13	26·6
Ditto	„ 5	1·490 × ·531	·791	21·20	26·8	2·06	25·7
Ditto	„ 7	1·500 × ·527	·790	21·20	26·8	2·22	27·7
				Means...	26·95		26·90

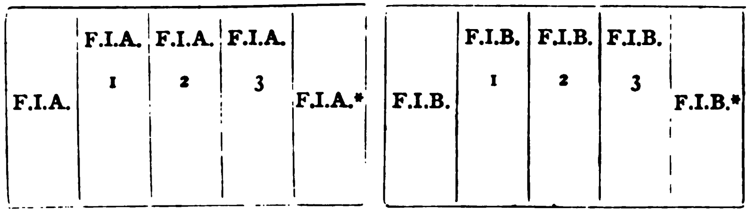
POSITIONS OF SAMPLES IN PLATE.

No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Annealed		Annealed		Annealed		Annealed	

TABLE VI.—*Results of Experiments to ascertain the Tensile Strength and Ductility of Specimens cut from two forged* IRON *Plates.*

Marks.	Dimensions.	Area.	Breaking Strains.		Elongation on 8 Inches.	
	Inches.	Sq. Ins.	Actual.	Per Sq. In.	Inches.	Per Cent.
			Tons.	Tons.		
F.I.B. 1	1·00 × ·795	·795	17·09	21·4	1·28	16·0
F.I.B. 2	·99 × ·795	·787	17·45	22·1	1·53	19·14
F.I.A. 3	1·00 × ·780	·780	15·26	19·5	·80	10·0
F.I.B. 3	1·00 × ·800	·800	17·45	21·8	1·58	19·7
F.I.A. 1	·985 × ·770	·758	15·75	20·7	1·17	14·6
F.I.A. 2	·970 × ·780	·756	13·88	18·3	·70	8·7
			Means ...	20·63		14·9

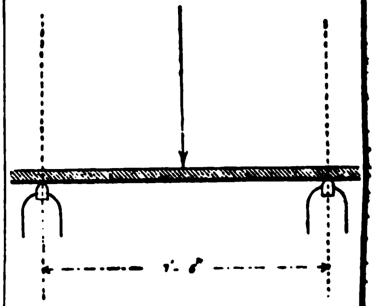
POSITIONS OF SAMPLES IN PLATES.



Deflection Experiments on Specimens cut from the same Plates as above Samples.

(Distance apart of bearing centres, 18 inches).

Marks.	Size of Specimen.										
F.I.A.	4·95″ × ·78″	Strain in pounds ...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,80	
		Set in inches ... Permanent set in ins.	·03	·06	·09	·11 None	·38 ·25	1·1 ·92	2·1 1·9	Still deflecting	
F.I.A*	4·95″ × ·73″	Strain in Pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,600	
		Set in inches ... Permanent set in ins.	·03	·06	·10 None	·20 ·07	·70 ·59	1·67 1·49	3·1 2·9	Still deflecting	
F.I.B.	4·96″ × ·79	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	
		Set in inches ... Permanent set in ins.	.c3	·05 None	·09 ·01	·14 ·04	·40 ·29	·98 ·85	1·88 1·70	Still deflecting	
F.I.B*	4·96″ × ·80	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	9,800
		Set in inches ... Permanent set in ins.	·05	·08 None	·11 ·01	·16 ·02	·23 ·11	·44 ·28	1·05 ·88	2·07 1·88	Still deflecting
		Mean Set... ... Mean permanent set	·035	·0625	·0975 ·010	·1525 ·0325	·4275 ·310	1·0475 ·885	2·0325 1·845		



(*To be continued.*)

THE RUSSIAN YACHT.

The *Fairfield* Yacht for the Czar, and vessels of her type considered as means of International Communication.

Paper read before the Fairfield Association of Engineers and Shipbuilders.

By E. E. GOULAEFF, Captain of the Corps of Naval Architects, R.I.N., Ad.C., F.R.S.N.A., M.I.N.A.

GENTLEMEN,—In a few days you will see one of the most remarkable pieces of naval architecture glide gently into the waters of the Clyde. Already hundreds of people have visited the Fairfield Yard, coming nearly from all parts of the globe to see this wonderful ship, intended to serve as the sea-going yacht for the Emperor of Russia, and the interest in her seems to be growing with the growth of the ship.

So novel is this vessel, both in her principal features and in all her details, that her construction shows wonderful combination of ideas and foresight, proving the extraordinary amount of inventive genius in the mind of her designer.

Being asked by your chairman to read a paper at this Institution, I could not refuse this offer, as I considered it a great pleasure and honour to be able to speak before the Fairfield Association of the "Fairfield child." But, in doing so, I must apologize at starting for my bad English, trusting you will excuse me, as my poor knowledge of your language comes only through my not being a Scotchman.

It seemed to me more suitable, on this occasion, to describe to you the ship herself in as few words as possible, giving only her principal features, and the main objects which were in view in designing her, and to dwell largely upon the probable development of this class of ships, when adapted for great peaceful and beneficial purposes.

This vessel is 235 ft. long, 153 ft. broad, and has a draught of 6 ft. 6 in. She might have been a little longer, but on closer investigation it was found that the addition of some 25 ft. or 50 ft. to her length would not have reduced the resistance in water. Augmentation of skin friction, not being sufficiently compensated by the improved lines would have required increased power to drive the larger vessel with the given speed. She might have been a little narrower to suit the taste of most people, yet the beam of 153 ft. cannot be regarded as being too great if we bear in mind the main object of her design, namely, the desire to secure the greatest steadiness.

Her small draught is perhaps the most peculiar of her features. Experimental analyses, agreeing with actual results derived from the trial trips of extremely broad vessels existing in the Black Sea, prove that at certain speeds a very much broader vessel requires only half as much power compared with another vessel of similar form whose draught is double. This is represented on one of the diagrams. The upper curve shows the resistance of the circular vessel, 120 ft. long, 120 ft. broad, and drawing 13 ft. of the same displacement as the yacht, whilst the lower curve represents the resistance of the yacht drawing 6 ft. 6 in. Hence the importance for the vessels of that class to have the smallest possible draught, and hence the anticipation that great speeds are not incompatible with this form. The late Mr. W. Froude, who conducted at the request of Admiral Popoff, some experiments with the models of vessels of his design, was the first to demonstrate by exact data the influence of draught on the reduction of resistance. No doubt, such reduction of the total resistance, with the reduction of draught and the increase of other dimensions, is owing to a great diminution of the wave making; indeed, the diagram proves that the advantage of the shallow ship increases with the increase of speed, and, as you all know, at great speeds, according to Froude, the most important portion of the total resistance is the wave making. Such considerations and reasonings, agreeing, as I have stated, with actual trials of existing vessels—one broader and shallower than another—determined the small draught which has been given to the yacht.

Thus we see that, under the circumstances, the principal proportions of the yacht could scarcely be altered in any way to the advantage of the ship.

Having specified the extreme dimensions, I will draw your attention now to the form of this vessel.

The form of underwater portion was made a subject of very careful study. Besides the great experience of the designer of the ship, Admiral Popoff—experience which he derived by spending the greater portion of his lifetime, either on the ocean, or in constructing novel ships, and trying them at sea—Dr. Tideman, member of the Academy of Amsterdam, was invited to assist in the determination of questions connected with the resistance of the yacht.

In the case of this shallow draughted vessel, the fine lines must be the vertical sections, whereas the fine lines of the ordinary steamer are the water lines or horizontal sections. Such change has been brought about by passing from long, narrow, and deep forms of ordinary vessels to the proportions of short, broad, and shallow ones; and, as has been demonstrated by experiments with paraffin models, the sharpening of buttock lines is more essential in this case than sharpening of water lines. In other words if the motion of an ordinary vessel may be compared with that of a wedge propelled vertically, the motion of the yacht ought to be compared with the same wedge propelled through the water horizontally. On looking at the stern of the actual vessel you will observe that the whole motion of the water between the stern tubes will be affected solely in the direction of the vertical sections, or the buttock lines. The diagrams give the principal sections and plans of the yacht. You will see that a large superstructure has been built upon the main body of the turbot-shape of the dimensions and of the form I have just mentioned. This superstructure is of the shape of an ordinary vessel, and because being of usual form, will no doubt gratify the eye of those who are not sufficiently educated to admire the uncovered sides of the lower turbot portion of the ship, which, however, are the very parts that have the greatest share in limiting the rolling at sea. Waves, from whatever point of the compass, developed either by the motion of the ship at very high speed, or by the capricious will of Nature, will ascend up the rounded sloping sides of the vessel, but finding there perfect freedom for their play, will have soon to subside, as the sloping deck is of a shape that does not admit of green seas remaining long upon it, unless in the form of a very thin sheet of water, quickly disappearing altogether. No additional buoyancy, therefore, is created alternatively at either side of the ship, and hence the rolling becomes a motion which, in the big waves, might follow the steepness of the swell, and, in small waves, actually reduces itself to nothing. Very often when on board a circular ironclad steaming in a gale, watching the behaviour of the boisterous seas about the rounded deck of the vessel, I was lost in admiration of the fruitless attempts made by the picturesque phosphorescent waves—illuminated brightly, on a dark night, from underneath by the deck-lights—to produce any influence on the majestic steadiness of the ship. At that time, my deficiency in painting prevented me from the reproduction on canvas of my impressions. Here, before you, gentlemen, feeling my deficiency in English, I am again prevented from giving to you a better description of the phenomenon; but to complete what I said regarding the behaviour of the seas about these vessels in heavy weather, I believe I cannot do better than to refer some of you, desirous of fuller information on that point, to the splendid articles which appeared in the *Times* newspaper from the pen of the eminent writer Mr. Reed, late Chief Constructor of the Navy, who described several passages made by himself on board of these typical vessels, and whose system of widening and shortening ships had much to do with the origin of the idea of circular vessels in the mind of Admiral Popoff. The parts beyond the superstructure already referred to, represent to you the extent of the palace carried by the yacht.

The turbot-like lower part of the vessel contains machinery, coals, and stores of all kinds. The steel superstructure rising over it contains accommodation for the crew forward, and for the officers aft, whilst the palace beyond it includes only the imperial apartments and the cabins for the suite.

This turbot-like portion of the vessel is built of steel, with a double bottom, whose height is no less than 3 ft. 6 in. in the centre. This double bottom is divided into forty water-tight compartments, and extends throughout the flat portion of the bottom. At the sides it is superseded by the cells formed by running two vertical bulkheads, right round the ship, and subdividing the distance between them and the outside skin into forty other compartments. These side cells, formed of continuous bulkheads, and covered by the plating of the rounded deck, present a very rigid, continuous annular structure, which has its lower points tied together by the radial girders, forming the bracket framing of the bottom, and by the heavy beams of the rounded deck, also radial, at the top. Thus the turbot-like portion of the vessel is made amply strong enough to withstand those forces which might be experienced in the roughest seas, and the local strains, such as those produced by the powerful machinery with which the ship is provided—particular attention being paid to the structure of the stern, in order to distribute the strains on the brackets supporting the propelling shafts of the side screws.

I need not go into the strength of the superstructure that rises above the turbot portion of the vessel, as it has been mainly designed to form a support for the palace and deck-houses beyond, in order to raise them so much above the level of the sea as to prevent anything but spray reaching those portions which are intended for the use of the imperial party.

The palace, as will be seen from the diagrams, is not so wide as the steel superstructure, so that all around it on the deck a continuous gallery is formed, which is used for stowing anchors, mooring the vessel, hoisting up boats, steam launches, and a small steam yacht, carried on the davits, which are supported by bridges projecting radially outwards from that gallery.

The roof of the palace is carried right over to the same width as the lower superstructure, thus forming an awning over the gallery shading from sun or rain the lower story of the palace, and widening at the same time the promenade above. Inside the lower story forward, and away from the heat and smell of the engines and galleys, are the apartments for the Emperor, and aft, those for the suite. Their number is not great, but their size is very much larger when compared with the cabins existing on board of any other ship. Accommodation of exceptional comfort had to be studied in this case. In the inside of the superstructure below here in the palace, the middle portion between the engine and boiler hatches is allotted to a passage across the vessel communicating with either end by means of two longitudinal passages, and also with the deck above. Such principal thoroughfare, by its convenience, marble pavements, electric lighting, &c., reminds one of the lofty staircases and spacious corridors in some palaces on land.

Beyond the promenade on the awning deck rises a reception saloon, whose height is 12 ft., and therefore greater than has been reached on board any other ship. In its forward part will play a fountain, surrounded by a bed of flowers. The whole decorative works of this saloon will remind us of the rooms of Louis XVI. at Fontainebleau, and the designs of this and other apartments were prepared by the well-known Scotch artist, Mr. W. Leiper. The drawing-room will be furnished in the Crimean-Tartar style, whilst other rooms will be of a simple kind of modern English, regard being made to obtain the greatest comfort.

Behind the funnels on the same awning deck stands another deckhouse, including rooms for the Grand Duke Constantine and the captain of the ship. Just in front of the funnels is the bridge, from which the ship will be governed, either by the steam steering gear acting upon her rudder, or by means of another gear designed for steering the vessel by means of her side screws.

It is scarcely possible to enumerate the improvements introduced in all their details. The system of distinguishing red, white, and green electric lights has been worked out under the guidance of His Imperial Highness the Grand Duke Constantine. The system of pumping out the water-tight compartments is deserving of special notice, as does also the town-like system of water service, to which, I believe, for the first time on board ship, there are added loaded accumulators to produce pressure when the steam pumps are not at work. Machinery has been employed largely to supersede manual labour, and there are no fewer than twenty-three separate steam engines on board for different purposes.

The propelling engines of the yacht, which have been designed by Mr. A. D. Bryce, are of a construction decidedly novel, and have been erected in a somewhat novel manner. Their foundation, which is of steel, forms part of the framing of the double bottom, as is also the case, on a smaller scale, in the circular vessels. We hope that, with many other important improvements introduced in these engines, we shall obtain a greater amount of indicated horse power, as compared with their weight, than with any other marine engine yet constructed (torpedo boats excepted), and that they will satisfactorily answer the problem entrusted by Admiral Popoff to Mr. Bryce.

The arrangement of propellers forms another very important peculiarity in the design of this vessel.

The efficiency of submerged screws beneath the ship's bottom has been sufficiently tested previously by Admiral Popoff, but so much as having two-thirds of their diameter entirely below the outline of the vessel is a decided novelty, which, as was expected, will greatly add to their efficiency, as has been corroborated by the recent experiments conducted to that effect, on Loch Lomond, with a steel model of the yacht one-tenth the ship's size. There are three screw propellers of 16 ft. in diameter, spaced 18 ft. 3 in. apart—the centre one being in the line of keel, and each of them worked by an independent engine capable of exerting an indicated horse power of 3,500.

Now, having described to you the vessel, I shall beg you to turn your attention to the second portion of the paper, namely, to "Vessels of her type considered as Means of International Communication."

During the last few years the means for such communication have reached a high state of development, and the great improvements introduced are already increasing and facilitating commercial, scientific, and friendly intercourse among the nations, and are tending to bring more and more the light of civilization to bear upon those portions of the human race whose isolation from other parts of the world was the only cause of their primitive state.

Already one immense line of railways crossing the Continent of Europe, or that of United States of America, from end to end, competes with another line of similar extent, in affording comfort to passengers and in saving so many hours in the journey. Every year the number of railway companies continuing to disregard the comfort of travellers is decreased, and with the sleeping and dining cars introduced on nearly all lines of importance, travelling is done with such ease that the journey becomes no longer a source of trouble but the reverse.

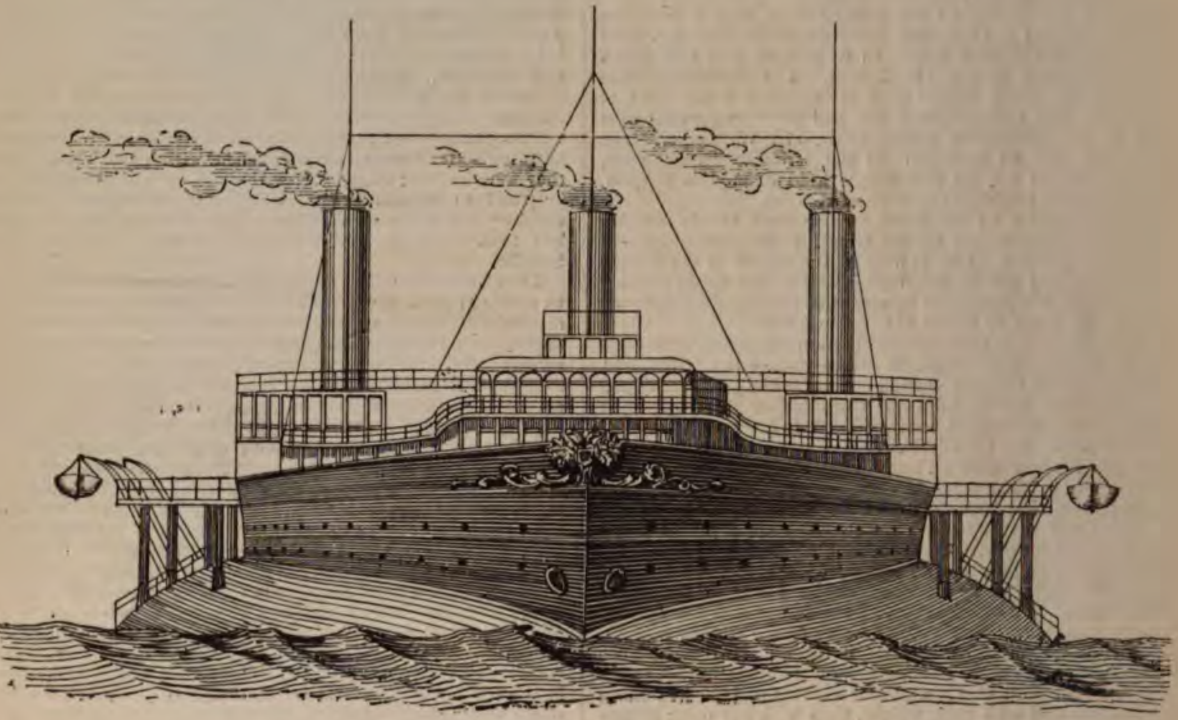
However important in relation to the economical development of separate States are the means of communication just spoken of, there are others which are scarcely of lesser importance, especially so in relation to commerce and civilization—and one of these is the steam navigation. I specified it the steam navigation, because only the application of steam insured the possibility of establishing an uninterrupted connexion of all parts of the world. So great is the demand for the means of emigration from the Old World to the New, often in very large masses of people, and the demand for the means of travelling, that already, at least one steamer a day is despatched from the shores of Europe to America, and, no doubt, the same will be the case with our communications with the other parts of the world, such as Australia, as soon as greater knowledge has been obtained of the climate and natural wealth of this new continent. Thanks to the continuous success in shipbuilding—success for which we are greatly indebted to the Clyde shipbuilders—already the distance to America has deen decreased to a week's journey, and to Australia, to a passage of one month. I know that Mr. Pearce is not satisfied with these results, though they were brought about partly through his own enterprise, and is prepared to surpass them, being ready to construct a fleet of steamers that will run the distance from Liverpool to New York in less than six days, and will establish the "Express" Ocean Service.

Thus we see that the great strides in steam navigation have given us nearly as good means of rapid locomotion at sea as have been reached by railways on land, but so much cannot be said in relation to comfort. Notwithstanding an ardent desire on the part of shipowners to turn their steamers into floating hotels, as convenient for living and as luxurious in their internal arrangements as are hotels on shore, people, with very few exceptions, regard a voyage by sea with mistrust, and even with dread at the thought of that helplessness to which are subjected both men and women, when the calm of the sea, so pleasant for travellers, changes into a heavy boisterous swell whose end no one can predict. No care in improving the internal accommodation, however luxurious—and, in most cases, more luxurious than the interior of the first-class railway carriage, at whatever expense to the owner of the ship the luxury is obtained—can alleviate these feelings of the masses of passengers. Fears of sea-sickness limit at present the number of travellers by sea actually to those who are obliged by necessity to go on board of a steamer of our day. Had the means existed to obviate, or at least to decrease, these great inconveniences—nay, sufferings—I can predict that the numbers of those travelling on board the steamers would be increased to an enormous figure, which would result in the construction of new vessels of still greater speed, and with still better accommodation. The intercourse between nations would become much wider, and the beneficent results of enlightenment and Christianity would spread to the most distant countries. The islands forming Great Britain remain, comparatively speaking, in a certain sort of isolation in relation to the people's customs and habits, which make the Englishman abroad so different from any permanent resident on the Continent. The cause of this, according to the opinion of an eminent politician of the present day, can be traced in small and very inconvenient means of Channel communication. If a distance of twenty miles by sea can produce so marked a difference in the people, it seems to me that what I said before in reference to the improvement of the means of communication between one part of the world and another must present itself to our minds still more clearly, and prove that ameliorations in this respect are to be regarded as matters of great importance in the history of the world.

So far, the attempts in the direction of improving the Channel communication—attempts which were met by every one of us with sympathies and hopes, which brought forth the design of such original vessels as the *Bessemer* and *Calais-Douvres*—have failed, and thus the field for improvements in that line remains yet open.

I say that the problem of combining comfort with sea voyages is yet to be solved, not because we are wanting in the knowledge of the principles, the application of which would reduce suffering from sea-sickness to a minimum, but because until the present time, there has been no opportunity for constructing a steamer on those principles specially intended for the combination of speed with extreme steadiness in a seaway.

The circular ironclads forming part of the Black Sea fleet were intended for purposes of coast defence, which confined them to a small speed of locomotion so as to be able to use the greater part of their displacement for the purpose of carrying their enormous guns and armour, which they do actually carry upon their extremely small hull. Quite indirectly, after the completion of those vessels and at the time of their extensive trials at sea, their wonderful steadiness in the heaviest seas was demonstrated, owing to their beam, absence of freeboard and rounded-up deck. Thanks to the voyage of the High Admirable of the Russian Navy, the Grand Duke Constantine, across the Black Sea to Batoum and back along the Caucasian shore, exactly a year ago, many of the distinguished gentlemen who had the honour of attending His Imperial Highness on that occasion. had the opportunity to witness for themselves the splendid behaviour of these extremely broad vessels at sea, and they ceased to believe any longer in those curious articles in some newspapers which were sufficient only to prove how very little the writers were acquainted with naval architecture and seamanship. During that voyage, the steamer *Penderaclia*, of ordinary proportions, had the full angle of rolling (on both sides) 72 deg., whilst the full arc through which the circular vessel rolled did not exceed 6 deg., or 12 times less. The *Penderaclia's* oscillations per minute was 20 against only 9 oscillations in the same space of time of the circular vessel. These eloquent figures speak for themselves. They were obtained by careful observations made simultaneously on board of each of these two vessels, which were specially placed in exactly the same condition in reference to the waves and the wind.

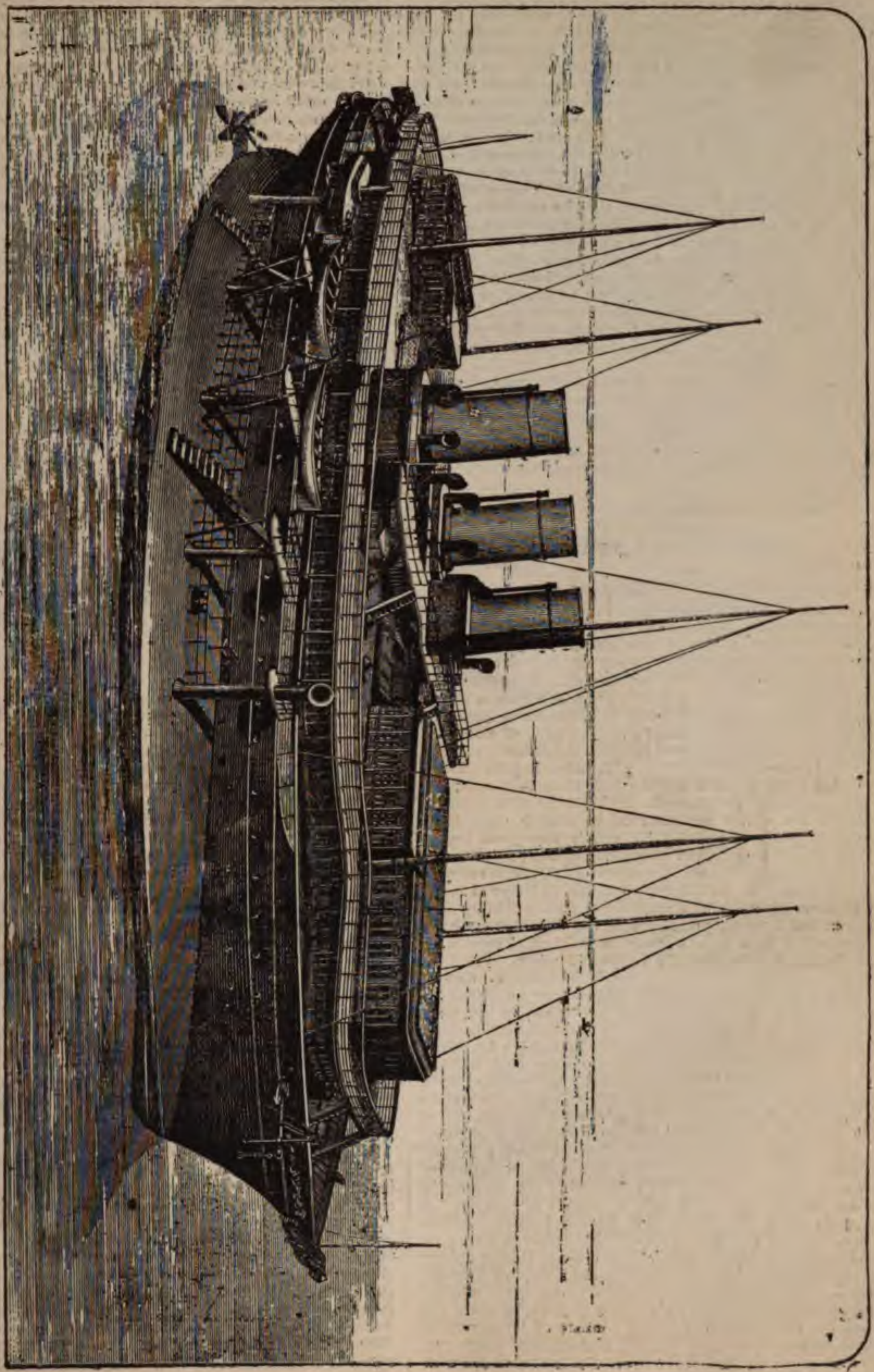


Two years ago the imperial yacht *Livadia* was wrecked. There was, therefore, a necessity for building another vessel to fulfil the purposes of the sea-going yacht. On this occasion H.M. the Emperor, on the recommendation of the Grand Duke Constantine, accepted the design of a new yacht prepared by Admiral Popoff. In recommending these plans H.I.H. desired to demonstrate by this vessel the capabilities and qualities of the very broad and shallow ships, when the strictly-defined problem of carrying heavy pieces of artillery and thick armour on a steady platform, capable of moving with moderate speed, is changed into a wider problem—to attain the greatest steadiness on the sea-way with great speed, not less than that of the yacht which was wrecked. Therefore the problem which was to be fulfilled in the new vessel is exactly the same as that upon the successful solution of which depends the wider range of the development of the means of international communication of the whole world.

In less than one year Mr. Pearce, the head of the most eminent shipbuilding and engineering firm in Scotland, and, as you all know, one of the most enterprising men of the day, after having gone through all the calculations of the vessel, and having satisfied himself as to the principles embodied in her design, has built the new yacht, and now she is so far advanced that she will be launched next week. Carrying the palace high above the sea admits of having such an amount of light and air in it as could not be attained in sea-going steamers of ordinary form; such a palace built on the ordinary form of vessel would, in a too dangerous degree, have reduced the stability. Three sides and the double bottom will prevent the ship from sinking should she be seriously damaged by collision or stranding. Three sides with a distance between them of not less than 6 ft., and extending all round the ship are incompatible with the narrowness of the present ordinary vessels. Three independent engines will insure the possibility of navigating the ship to the place of her destination with one or even two engines broken down—an advantage of which not one of the existing steamers can boast. After losing the rudder, the yacht is not left helpless—she can be handled as well by steering her by the side screws.

All investigations and experiments with models of the yacht tended to assure us as to the certainty of anticipated results in regard to the speed of this vessel; whilst the passage through the Bay of Biscay in the equinoctial autumn weather is awaited with greatest interest, not only by us, but by all who are watching the progress of the development of steam navigation, as on this voyage the yacht will be the very first vessel of such unusual proportions that will have been brought to face the waves of the Atlantic.

It is true, the *Livadia*—which is the name of the yacht I am speaking of—cannot be considered strictly as being intended for oceanic navigation. Her lengt has well as breadth is too small for



THE LIVADIA.

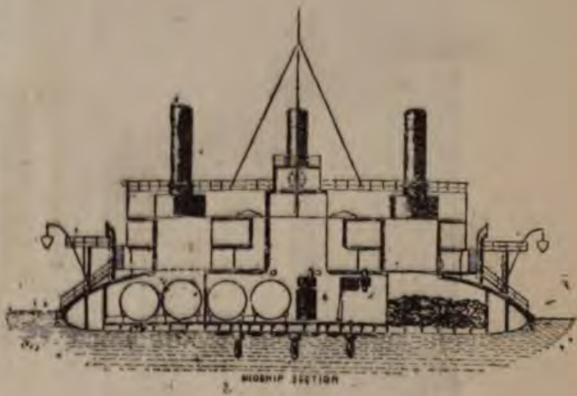
such service, the dimensions of the *Livadia* being determined by the desire to build the cheapest vessel of her kind.

Those acquainted with the question—How much the power of machinery is affected by the size of the vessel which has to be driven, will easily understand that it is impossible to compare the *Arizona* or the *Orient*, whose displacement is eight or nine thousand tons, with the yacht *Livadia*, whose displacement is not greater than four thousand tons. It is impossible, by taking such unequal representatives of two so different species, to compare their efficiency in regard to fuel consumed for a run of a certain distance. A smaller ship, of whatever form we take, will always have a disadvantage in point of economy; and this very reason makes the shipowners in advance of other persons to order already steamers like the *Servia* and *City of Rome*. When the same dimensions as those of these last two vessels shall be reached in ships having the form of the *Livadia*, and intended for trans-oceanic service, then the consumption of coal necessary to drive such vessels with the speed of ordinary ones will compare better. However, some exact data in this respect of greatest importance will, no doubt, be obtained from the trials of the yacht. Just on the eve of these trials it would be perhaps permature to speak of, and discuss, the expected performances of the yacht and the vessels of her class more than I have done. In conclusion, I shall refer to the subject of dock accommodation.

Docks capable of lifting vessels of the *Livadia* type, for the purpose of painting or repairs, have been already constructed and tested in the Black Sea. The system of single-sided floating docks (known as Messrs. Clark and Stanfield's system), adopted for extremely broad vessels by Admiral Popoff, does not any longer prevent the construction of vessels of any proportions.

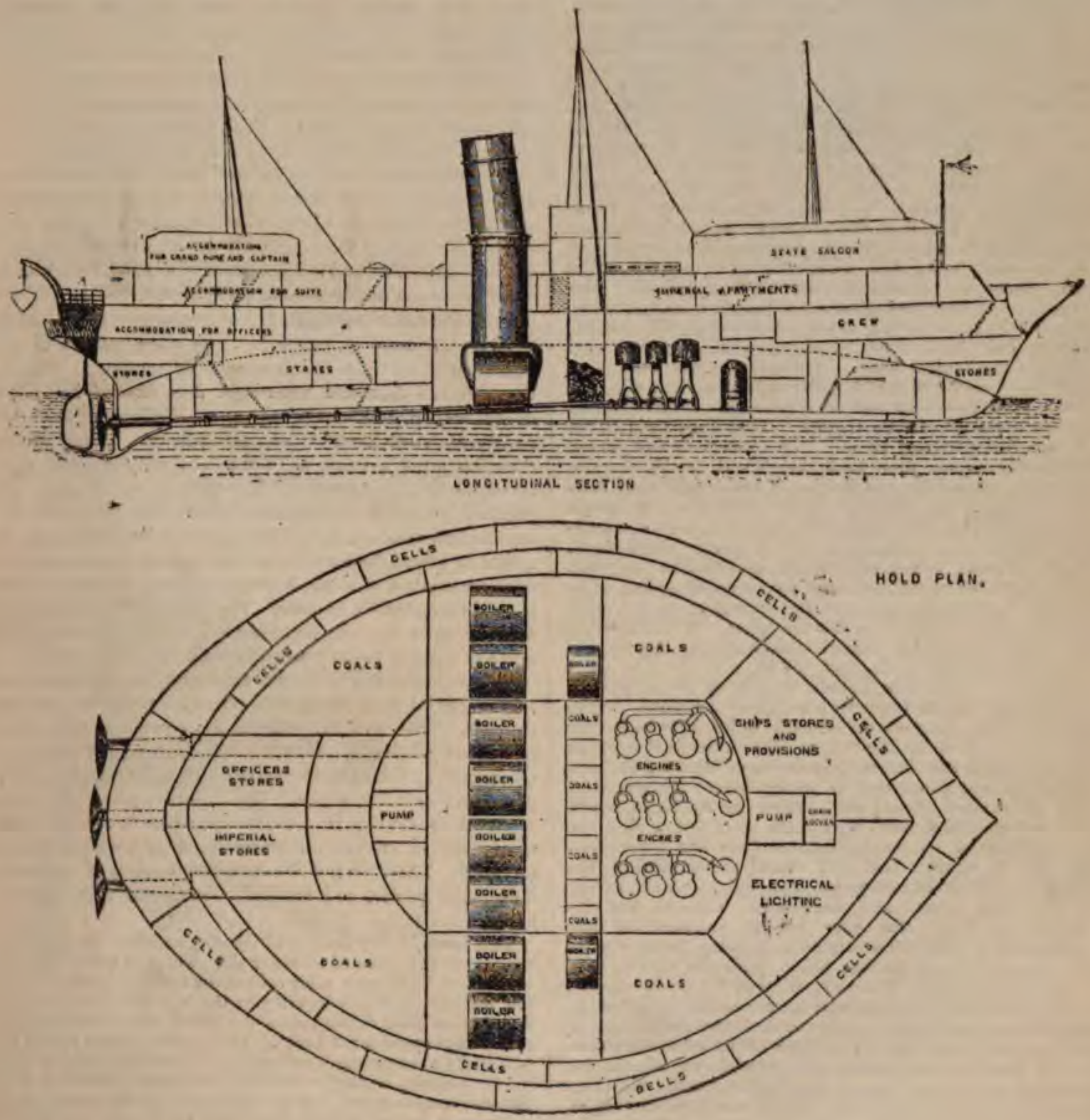
THE LIVADIA.

ON the 7th July, the *Livadia*, the new Russian Imperial yacht, was launched from the building yard of Messrs. John Elder & Co., Govan, near Glasgow, a description of which we have already given in the November number of this journal. The Czar's new yacht is in every way remarkable. To say nothing of the extraordinary comfort and luxury of the accommodation designed for the Emperor and his suite, the vessel is noticeable from a purely nautical point of view. She is the latest development of ideas that may fairly be said to be revolutionary and subversive of all established principles of shipbuilding, and of which the earlier specimens are found only in the circular ironclads of Admiral Popoff. Those ships have many fighting qualities that entitle them to respect, but they are not possessed of great speed. Hitherto the most visionary naval architect has always endeavoured to achieve exceptional speed in one way only—by giving his vessels very great length and the most perfect fineness and proportion of the perpendicular lines. The new Channel steamer, the *Albert Victor*, is an example of this kind of vessel. It is clear, however, that an Imperial yacht ought to be more agreeable as a residence than any existing seagoing steamer, and it seems probable that the constructors of the *Livadia* have solved in a novel manner the problem of combining speed with the spacious comfort of a good sized palace. Primitive man may, perhaps, have "learned of the little nautilus to sail," but the builders of the Czar's floating palace have constructed it on a hull shaped after the form of a turbot. Considering how well-adapted all fish are for passage through the water, there is nothing extravagant, though there is much that is new in taking a flat fish as the model of a vessel that has to satisfy very exceptional requirements. Speaking roughly, the *Livadia* must be imagined as a broad and shallow oval, half submerged, and carrying on its surface extensive lofty and sumptuous saloons and other apartments. It resembles a vessel of the ordinary kind, reposing upon a white air cushion. Its principal dimensions are:—Length, 260 ft.; breath, 150 ft.; depth, 50 ft.; tonnage, 11,609; and displacement 4,000. The advantages of the mode of its construction are thoroughly evident. In the first place the hull is capable of carrying on its back a great palace that would sink any other vessel. In the second place, the peculiar shape of the hull has a double merit; its enormous beam is certain to render the ship as steady as any vessel can possibly be, and its lower lines insure a very considerable rate of speed. The only question is how far that speed will be diminished by the action of the wind. Her engines, however, are very powerful. The propelling power consists of three sets of engines, each having three cylinders, the diameters of which are, for the high pressure, 60 in., and for the low pressure, 78 in., with a stroke of 3 ft. 3 in. The propellers themselves are of manganese bronze, thus securing strength and lightness; and with the view of obtaining the greatest possible power, steel has been largely used in the construction of the engines and boilers, which will be the most powerful in the world for their weight. The indicated horse power is 10,500, and the vessel is expected to make 14 knots an hour. The launch of the *Livadia* was the one great event at Glasgow, and visitors poured in from every direction early in the morning. The Grand Duke Alexis arrived by the night mail train from London, and Prince Lobanoff, the Russian Ambassador, reached Blythswood, the seat of Sir A. Campbell, on the previous day. Thousands of less distinguished sightseers went to Govan in the morning, and both banks of the busy Clyde, wherever a view of the *Livadia* could be obtained, were covered by crowds of holiday folk, many of whom took a keen professional interest in the vessel. Before noon, the hour fixed for the launch, Messrs. Elder's building yard was thronged by a miscellaneous crowd of ladies and gentlemen and workmen, all equally eager to see the ceremony. Several stands were erected, to which admission was by ticket, and the tickets were very liberally distributed; but the workpeople availed themselves of the sloping roofs of sheds and many even more precarious perches. During the few minutes that remained a hasty inspection of the vessel was allowed, and it was impossible on going on board not to be struck by the height of the decks that tower above the hull, till at the top of all one reaches the reception saloon, in which when all is ready a fountain will be placed, and which is at least 40 ft. above the level of the sea. Peeping over the taffrail, one could see the three screws, one at each side and one immediately behind the rudder, all of them about to be submerged. This is another novel feature of the vessel. One or even two of the screws might be disabled without rendering the vessel unmanageable, and the side screws can, of course, be used on occasion for steering purposes. Their total submersion is an economy of force, and has been attained by the gradual inclination of the shafts from the engines, which, in order to preserve the necessary vertical position of the screws, are placed somewhat more forward than is usual. At twelve o'clock the Duchess of Hamilton arrived with the Grand Duke Alexis, Prince Lobanoff, Admiral Popoff, and other Russian gentlemen. On the centre platform an altar was extemporized, in front of which three priests of the Greek Church, in green and gold vestments, chanted prayers and hymns, the responses being sung by a body of ten or a dozen Russian sailors, who had formed the Grand Duke's guard of honour on his arrival at the railway station. At the conclusion of the service, which lasted nearly a quarter of an hour, one of the priests, taking an asperge in his hand, sprinkled holy water over the bows of the yacht, and the Duchess of Hamilton came forward and put the finishing touch to the ceremony. Only the last dogshores now held the *Livadia*, and the Duchess with a chisel easily cut through the cord that kept up the heavy weights, which are so arranged as to knock them away instantly. The great yacht took the water, the people cheering, and the band of the 74th Regiment playing "God Save the Queen." Three powerful tugs took charge of the *Livadia* and brought her alongside the building yard. A great crowd of at least 10,000 persons had gathered on the Partick side of the water, many of them dangerously near the river; but,



though the vessel sent up a heavy swell, no one was washed away. Apparently the calculations of the builders have been exactly verified, for without her engines and other fittings, the *Livadia* at present draws no more than 5 ft. of water. It may be mentioned that the breadths of her keelless bottom greatly increased the friction that had to be overcome, and made the launch a task of more than common anxiety. Fortunately, no difficulty was experienced and no accident occurred. After the launch the Grand Duke and the Duchess of Hamilton and some others of the visitors made the tour of the yard and examined the *Livadia's* engines and boilers. At the luncheon, at which Mr. Pearce, representing the firm, presided, a very numerous company was present, including the Grand Duke, Prince Lobanoff, the Duchess of Hamilton, Admiral Popoff, the Earl of Eglinton, Sir A. Campbell and Lady Campbell, Captain Goulaieff, General Gorloff, Admiral Sir Houston Stewart, and many others. After the toasts of "The Queen," "The Czar of Russia," and "The Imperial Family of Russia," the Grand Duke, responding for the toast of his health, expressed his satisfaction at visiting Glasgow, the centre of the intelligence of the country. Admiral Popoff proposed the health of the chairman, who in reply, gave the toast "Success to the *Livadia*." He said that he had derived his idea of the vessel from Admiral Popoff, and though at first the plans were regarded as experimental, he now felt confident of success. The design probably would be more valuable for men-of-war than for merchant vessels, but the latter, too, would be able to take many hints from the peculiarities of the the new ship. Singular as her shape was, her speed would be about 14 knots an hour. After the launch the Grand Duke paid a short visit to Hamilton Palace, and then returned to London.

THE LIVADIA.—Longitudinal Section.


ACCOMMODATION FOR GRAND DUKE AND CAPTAIN
ACCOMMODATION FOR SUITE
ACCOMMODATION FOR OFFICERS
STORES
STORES
STATE SALOON
IMPERIAL APARTMENTS
CREW
STORES
LONGITUDINAL SECTION
HOLD PLAN.
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IMPERIAL STORES
PUMP
ENGINES
ENGINES
SHIPS STORES AND PROVISIONS
PUMP
CHAIN LOCKER
ELECTRICAL LIGHTING

THE NEPTUNE.

THE double-turret ship *Neptune*, late the *Independencia*, completed her gunnery trials on July 15th at the back of the Isle of Wight, under the superintendence of Captain Hopkins, of the *Excellent*. At the previous trial a fortnight ago the practice was from the 12½-ton guns in the forecastle, and from her turret armament of four 38-ton guns, the purpose of the latter firing being to test the endurance and efficiency of the hydraulic gun gear, which had not been tried since it was put on board by Sir William Armstrong's firm, and which had, besides, undergone various modifications to adapt it to the change which had been made from the Whitworth 36-ton guns to the service 38-ton 12½-in. guns. The object of the present trial, which was confined to the turret guns, was to test the capacity of the plate compressors by themselves to check the recoil of the guns in the event of the hydraulic presses being disabled, and also to ascertain the effect of the concussion of simultaneous and electric broadside discharges upon the boats on the hurricane deck above the turrets, and upon the deck structures. There were 19 rounds fired altogether with ordinary and battering charges, viz., six from the after turret and thirteen from the fore turret. It appeared that the great destruction of glass which occurred at the former trial had had the effect of inducing the Admiral Superintendent to limit as far as possible the damage on the present occasion. With this intention, therefore, the whole of the rounds, with two exceptions (and these with light charges), were fired on the starboard, the inference being that what occurred on one side of the ship would, under like conditions, occur on the other side. The rounds, again, were delivered almost exclusively from before the beam, Admiral Foley objecting to the cabin fittings, which must, of course, take their chance during an engagement, being destroyed during merely experimental firing. The main purpose was to test the strength and stability of the forecastle superstructure; but even here certain chalk-marks on the deck indicated the limit beyond which the guns should not be trained. That limit was fixed at 68 deg. before the starboard beam. It is noteworthy that, in the first simultaneous rounds from both turrets with 100 lb. charges, one of the pairs missed fire, the absence of recoil sufficiently indicating to the gunner the refractory gun. The first four rounds from each turret were fired with the hydraulic presses disconnected and with the plate compressors only in use to check recoil. With 100 lb. charges, 10 deg. of elevation, and trained to 35 deg. abaft the starboard beam, the fore turret guns recoiled 47 in.; while the after guns in like circumstances, but trained to 20 deg. abaft the starboard beam, recoiled 39 in. and 48 in. With battering charges of 130 lb. and Palliser chilled shot weighing 800 lb., the fore turret guns recoiled 53 in. and 50½ in., and the after guns 57 in. and 60 in. These four rounds were fired as an electric broadside from the conning tower with 2 deg. of elevation. In the remaining rounds the hydraulic presses, the valves of which were weighted up to 1,000 lb. to the square inch, were used to check recoil, the guns being fired horizontally and with battering charges. The lowest recoil was 46 in., fired at 50 deg. before the starboard beam, and 59 in. fired at 62¾ deg. before the starboard beam. During the firing several men who were stationed under the forecastle experienced no unpleasantness from the concussion, and they were of opinion that they could have worked the guns readily. The concussion on the fighting-deck below, however, was very great, and considerable damage was inflicted during the trial. The glass fell in showers, as was to be expected; but the situation became more serious when the upward rush of air from below to fill the vacuum produced on the weather deck by the explosion of the heavy charges carried away the cover of the capstan head and lifted the deck in the wake of the capstan bodily to such an extent that the stanchions were torn from their fastenings. The whole of the forecastle superstructure will require strengthening. A panel in the chart-house was smashed, the grating of one of the coaling scuttles was lifted from its place and carried away, and a cutter which was resting on crutches on the port side of the hurricane deck parted all along the keel on both sides, and had one of its sides blown away outwardly. Several rivets and bolts in the glacis plates were broken and loosened, and much smaller damage was caused. The turret gear answered admirably, notwithstanding the severity of the ordeal through which it was put. The concussion of the charges, however, upon the structure of the vessel itself was felt to such a degree as to suggest many painful reflections as to the effect which the firing of the 80-ton guns will have upon the *Inflexible*, and it is understood that the naval authorities are already considering the expediency of reducing the charges.

THE NEW CRUISERS.

THE three second-class cruisers which have just been ordered to be built by contract are to be named the *Leander, Phaeton*, and *Arethusa*. These vessels will be very similar to the *Iris* and *Mercury*, which are cruisers of the first class, but will differ from them in some important respects. The chief modifications are that the engines will be of less power in the new ships than in their predecessors, and the weight thus gained will be applied to the fitting of an under-water armour deck over the engines, boilers, and magazine, and in increasing the amount of coal carried.

The principle dimensions of the second class cruisers will be the same as in the first class, viz., 300 ft. in length, between perpendiculars, and 46 ft. in extreme breadth, with a load displacement of 3.700 tons at a draught of 19 ft. The armour deck will consist of two thicknesses of ¾ in. steel plating, placed slightly below the water at the centre of the ship, and rounded down to some 3 ft. or 4 ft. below it at the sides. Coal bunkers capable of containing 1,000 tons of coal will be ranged at the sides and ends of the engine and boiler spaces both above and below the armour deck, thus admitting of a very perfect system of coal protection for the machinery, in addition to the protection afforded by the 1½ in. steel deck. The hulls of the vessels will be constructed entirely of steel on the longitudinal and bracket-frame system, with a double bottom, many important improvements being introduced in the design to simplify the constructive details and secure a *maximum* of strength with a *minimum* of material. The ships will be divided into numerous water-tight compartments by transverse bulkheads, by the protective deck and water-tight flats forward and aft, by the double bottom, and by the magazines, shell-rooms, shaft passages, and numerous divisions of the coal bunkers. It may be remarked that the great number of water-tight sub-divisions, with their inevitable accompaniment of water-tight doors, drainage, and complicated pumping arrangements which the exigencies of naval warfare now demand, have received special consideration. Even in a time of peace, these and also the working of the coal after all is done are matters of some delicacy, and how they will be managed in action remains to be seen. The designs for the new vessels, however, show that the importance of simplifying these matters as much as possible has not been lost sight of at Whitehall.

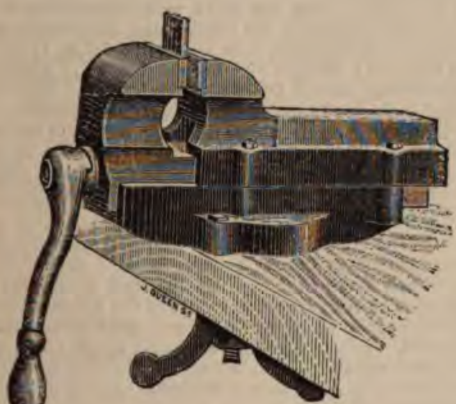
The engines are to be simple twin-screw engines of the horizontal compound type, each with one high and one low pressure cylinder. They will be arranged in separate engine rooms, one immediately before the other, for the starboard and port propellers respectively. Steam will be supplied by eight circular steel boilers placed in two boiler rooms. The collective power the engines are expected to develop is 5,000 horses, which is estimated to give a mean speed of 16 knots on the measured mile, with all the weights on board. The *Iris* and *Mercury* have engines of somewhat over 8,000-horse power, and attained a measured mile speed of 18½ knots.

The form of the hulls and the displacement are practically the same as in the *Iris* and its sister ship, which, it will be remembered, was determined upon after exhaustive model experiments made at the instance of the Admiralty by the late Mr. Froude to ascertain the form of least resistance for the given length and displacement at the high speed of 18 knots. The wisdom shown by the Director of Naval Construction in calling in Mr. Froude's valuable assistance has been conspicuously exhibited by the results obtained in the first two ships, and augurs well for the success of those now ordered.

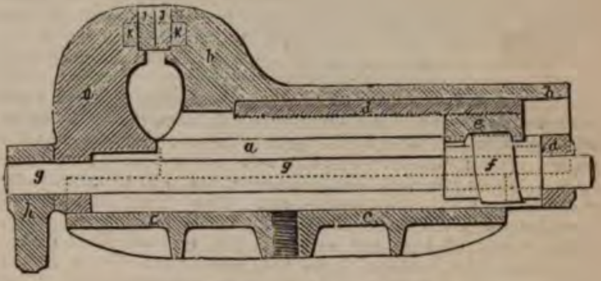
The new cruisers will be fitted with all the latest improvements, including steam-starting gear, Whitehead and other torpedoes, machine guns, electric lights, &c., and each will carry a couple of second class torpedo boats. The armament, we believe, is at present undecided, but will probably consist of a revolving gun on the forecastle and poop, and nine guns at the stern and broadside ports on the upper deck. The *Iris* and *Mercury* carry ten 44-pounders each, similarly arranged. The contract for the hulls and machinery of the whole of the three vessels has been intrusted to Messrs. Robert Napier & Sons, of Glasgow, who have undertaken to deliver them in two years.

AN INSTANTANEOUS GRIP VICE.

It has been well said that success in manufacture depends upon attention to details. The most apparently trifling waste of time will, in the aggregate, be sufficient to materially reduce the profits. One of these causes of waste of time to which far too little attention is paid, is the ordinary screw vice. The fitter is so accustomed to the use of this vice and to its deficiencies, that it is difficult to persuade him that its inconvenience is great. However, the party much more affected in his pocket is the employer, who will suffer for the time required by the fitter to operate an ordinary screw vice. This may not appear to be of much consequence to an outsider, but those who are familiar with bench work will, we think, agree with us in our following statement as to the way in which time is lost at the bench. First, take the case of a fitter chipping or planing an ordinary bearing brass, very wide one way, and very narrow the other, across the crown. In order to grip the brass across the crown, the vice has to be screwed up by several turns of the handle, and then when it is required to grip the brass across the wider part, the vice has once more to be slacked, the brass laid on the bench, the vice extended by several turns of the screw, the brass picked up and tried in the jaw, probably the brass again to be put down and the jaws to be readjusted, the brass again to be held in position and a comrade called up to grip the brass whilst held in proper position. This is no sooner done and the chipping commenced, when probably the brass slips, owing to the grip of the widely-extended jaws not being parallel, but only partial, and in a wedging manner. The whole operation has then to be repeated.



Messrs. Entwisle & Kenyon's Instantaneous Grip Vices are designed especially to obviate these objections to the old screw vice, and are certainly the simplest and most practical solutions of the problem that we have seen. Our illustrations show an outside view and section of the vice, which it may be seen bolts by a fly-nut to the bench, and may be readily turned to any required angle for getting most conveniently at the work—*a* is the loose sliding jaw, whilst *b* is the fixed jaw bolted to the bench plate *c*; *g* is the shaft or bar carrying an eccentric cam *f*, which carries and works into a sliding shoe or nut, *e*, which is made of steel, and has its upper surface serrated or toothed, so as to gear and grip into an upper serrated steel rack, *d*. A half turn of the handle and shaft unlocks *e* out of gear entirely with *d*, so that the moveable jaw and shaft may be readily moved to any required distance from *b* to suit the work. It is arranged that the handle shall be up vertical when the jaw is loose. The work can thus be held in both hands with the upright handle prevented from falling between the arms. The loose jaw may be then pushed by the body so as to touch the work, and it is immediately gripped by allowing the handle to fall down by its own weight. This grip will be sufficient to hold the work so as to free one hand, which can then be used to put pressure on the handle to give an equally powerful grip to that of the screw vice, and which can be relied upon not to slip with chipping or other jar.



This vice, in addition to the above handiness, possesses the valuable quality of always giving a parallel grip, and thus obtaining the best hold and not denting the work.

There can be no doubt as to the durability of the "Instantaneous Grip-Vice" as there are few working parts, the cam being the only rubbing surface. The racks are of steel, and do not rub, but only engage into one another, and should therefore last an indefinite length of time. As Messrs. Entwisle & Kenyon have laid down special machinery for their manufacture, the work and finish ought to be first-rate and interchangeable. The jaws are of steel, and removable by a special manner of fixing.

We are indebted to Messrs. C. S. Mallett & Co., Sole Agents for London, of 9, London Street, Fenchurch Street, for the above particulars.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Lizzie English.—On the 22nd June, there was launched from the shipbuilding-yard of Messrs. Turnbull & Sons, Whitby, an iron screw steamer of the following dimension:—Length 257 ft.; breadth, 34 ft.; depth, 19.9 ft.; her gross tonnage will be upwards of 1,700 tons. Her engines, of 150-h.p., will be by Blair & Co., Stockton-on-Tees. The vessel is built to the order of G. Pyman, Esq., of West Hartlepool, under special survey of hull and engines, and is classed 100 A 1 at Lloyd's. She is intended for the Mediterranean and Indian trades. As she left the stocks she was christened the *Lizzie English* by Miss Lizzie Cory.

Triumph.—On the 23rd June the largest steamer yet built at Middlesbrough was launched from the dockyardof Messrs. Raylton, Dixon, & Co. Her dimensions are:—Length, 352 ft.; breadth, 37 ft.; depth of hold, 27 ft.; gross register tonnage about 3,000 tons; carrying capacity, 4,000 tons. The *Triumph* has been specially built and fitted for the Atlantic trade, not only to the highest class at Lloyd's, but having also an immense amount of additional strengthening, so as to make her one of the strongest steamers afloat. She is a flush-decked vessel, with a hood or sheltered deck for protection at each end, all houses and erections on deck being of iron; her main and upper decks are both of iron, the latter being covered with wood. Steam steering gear will be fitted amidships as well as aft, and many novelties have been introduced in the details of her construction. The engines, which are of 300-horse power nominal, and about 1,500 effective horse-power, are being constructed by Messrs. Blair & Co., of Stockton, where the vessel will be taken immediately for them. The *Triumph* has been built to the order of Messrs. Hutchinson & M'Intyre, of Newcastle, the predecessors of the present firm of Messrs. M'Intyre, Bros. & Co.

Ogwen.—On the 23rd June there was launched from the Iron Shipbuilding yard of Mr. Robert Foster, South Dock, Sunderland, an iron sailing ship, built to the order of the Arron Shipping Company, Caernarvon, of the following dimensions:—Length, 241 ft.; breadth, 36½ ft.; depth of hold, 22 ft. She is fitted with full poop, topgallant forecastle, and deck-house, built to the highest class in both Lloyd's and Liverpool Underwriters' Registry, fitted with patent capstan, windlass and all other latest improvements. A large deck-house of teak is fitted amidships with accommodation for petty officers. On leaving the ways the vessel was named the *Ogwen*, by Miss Foster, of Sunderland.

Ben Or.—On the 23rd June there was launched from the building-yard of Mr. William Pickard, at Appledore, a barquentine of the following dimensions:—Length, 114 ft. 2 in.; breadth 24 ft. 1 in.; depth. 12 ft. 9 in.; tonnage 226 tons (N.N.). She is the property of the builder, and is named the *Ben Or pro. tem.* She will be registered at Bideford, and is intended for the general foreign trade.

Alice Kate.—On the 23rd June there was launched from the building-yard of Mr. H. L. Read, at Saundersfoot, a schooner named the *Alice Kate*, 87 tons register, about 155 tons d. w., built for Captain Murphy, of Wexford.

Speedwell.—On the 24th June a new iron screw steamer was launched from the iron shipbuilding-yard of Messrs. Hodgson & Soulsby, at Cowpen Quay, Blyth. As the steamer glided into the water she was named the *Speedwell* by Miss Edith Proctor, of Newcastle, daughter of one of the owners. The vessel is of the following dimensions:—227 ft. long, 30 ft. 2 in. broad, and 17 ft. 10 in. in depth of hold, and will be able to carry about 1,500 tons. She is classed 100 years A 1 at Lloyd's. The steamer's engines will be 100-horse power nominal, and will be fitted by Messrs. Black, Hawthorn & Co., of Gateshead. The *Speedwell* is the property of Messrs. Adler & Proctor, of Newcastle, and is intended for the Baltic and Mediterranean trades. She will be commanded by Captain Jasper Tate, of South Shields.

Daring.—On the 23rd June a yacht was launched from the shipbuilding-yard of Mr. H. Harnden, Salcombe, built for Mr. F. R. Kennedy. Her dimensions are:—Length, 46 ft.; beam, 11 ft. 6 in.; and is 23 tons builder's measurement. Her rig is a polemasted schooner. Miss Wells named her the *Daring*. She will be registered in the port of Salcombe.

Camargo.—On the 26th June, there was launched from the yard of Messrs. Pickersgill & Sons, of Southwick, Sunderland, a screw steamer, built to the order of Messrs. R. & W. Jones, of Newport (Mon). The vessel is designed to carry a large cargo on a light draught of water, and is intended by her owners for general work. She is 208 ft. long, 30 ft. broad, and 15 ft. deep, and is fitted with a long half-poop, bridge houses, and topgallant forecastle. Her water ballast tanks are upon the M'Intyre principle. Diameter of cylinders 26 in. and 47 in. respectively, and length of stroke 36 in. The vessel has been built under the special survey of Lloyd's Surveyors, and will be classed 100 A 1, the highest grade in the Registry. Captain Le Pelley, of Guernsey, is to be her future commander. As the vessel was leaving the ways she was christened the *Camargo*, by the wife of the Captain.

John Marychurch.—On the 26th June, Messrs. Sampson & Sons launched from their ship-building yard, Sunderland, an iron-screw steamer, built to the order of Messrs. John Marychurch & Co., of Cardiff. The vessel is of the following dimensions, viz.:—Length, 269 ft.; breadth, 36 ft.; depth of hold, 17 ft; built on the cellular system, under special survey, and is of the highest classification at Lloyd's 100 A. The engines are 130-horse power nominal, on the compound surface condensing principle, by Mr. John Dickenson, of Palmer's-hill Engine Works. The vessel is constructed with a full poop, long raised quarter deck, bridge-house amidships, and full topgallant forecastle, four horizontal steam winches and patent windlass, and will be fitted likewise with steam steering gear and other modern improvements. She is intended for the Atlantic and Mediterranean trades, and will sail under the command of Captain Thomas Seaward. The naming of the vessel—*John Marychurch*—was performed by Mrs. Seaward, of Beer, Devonshire.

Glowworn and *Firefly.*—On the 3rd July Messrs. R. & H. Green, shipbuilders, Blackwall, London, launched from their shipyard two screw steamers, to the order of Messrs. Pickford & Co., carriers, London. The first was named the *Glowworm* and the second the *Firefly*. These vessels are intended for the Portsmouth and Isle of Wight goods traffic. They are fitted with steam winches and all the appliances for facilitating the loading and discharging of cargo. The dimensions are—Length, over all, 75 ft.; beam, 14 ft.; depth (moulded) 7 ft. 7 in.; draught of water, loaded, 5·6. These are the first steam vessels of Messrs. Pickford & Co.'s fleet. They are very strongly built (equal to Lloyd's highest class) and capable of carrying a very large cargo on the above dimensions, having no less than 3,500 cubic feet of cargo space. The engines are by Messrs. Seaward & Co., engineers, Millwall, and are of the compound surface-condensing type, having cylinders of 12 in. and 22 in. diameter respectively, and a stroke of 15 in.

Forest.—On the 5th July, there was launched from the shipyard of Palmer's company at Jarrow, a screw steamer, built to the order of Messrs. Moral, Brothers & Co., Cardiff, and which was named the *Forest*, by Miss Armstrong, daughter of the Shipyard Manager. The dimensions of the vessel are:—Length, 240 ft.; breadth, 33 ft.; depth of hold, 18 ft.; carrying capacity, 1,950 tons; engines, 120-horse power nominal. The *Forest* is intended for the Bilbao and general trades, and has been constructed to carry a heavy cargo on a light draught of water.

Envoy.—On the 8th July there was launched from the shipyard of Messrs. Raylton, Dixon & Co., Middlesbrough, the second of two sister ships, which they have recently built to the order of Messrs. Edward Harris & Co. These vessels are 180 ft. long by 30 ft. beam, by 13 ft. 11 in. depth of hold; they are of a gross register tonnage of about 733 tons, and will carry 960 tons; they are built with long raised quarter decks, both decks being of iron, have water ballast in forehold and engine room, two steam winches, Emerson Walker & Co.'s Patent Combustion Windlass and engines, &c., and fitted with engines of 80-horse power nominal, by Messrs. Blair & Co., of Stockton. On leaving the ways she was christened the *Envoy* by Mrs. Simpson, of Saltburn, the wife of one of her Owners.

Coot.—On the 8th of July, a cutter yacht was launched from the shipbuilding-yard of Mr. Henry Harnden, Salcombe, she being built to the order of Mr. J. F. Froude, of 5, Onslow Gardens, London. Her dimensions are:—36 ft. 6 in. in length, 9 ft. beam, and 6 ft. deep. She was named the *Coot* by Miss Mabel Harnden.

Alexandre Bixio.—On the 8th July Messrs. M. Pearse & Co. launched from their iron shipbuilding-yard at Stockton an iron screw steamer of the following dimensions:—Length between perpendiculars, 300 ft.; extreme breadth, 36 ft.; depth of hold to top of floor, 25 ft. 6 in. This vessel is about 2,300 tons gross register, aud will carry about 3,300 tons dead-weight, at about 22 ft. draught of water. She is built of the highest class granted at Lloyd's. This very fine vessel is built off the three-decked rule, with two decks laid, both being of iron. She will be rigged as a three-masted schooner, and will carry double topsails on the foremast. She will be provided with engines on the direct-acting surface-condensing principle, of 280-horse power nominal, from the establishment of Messrs. Blair & Co., of Stockton, four steam winches, patent steam steering gear, has double bottom for water ballast, and all the most recent and improved appliances for expeditiously loading and discharging cargoes, and for ventilation and other sanitary purposes. As she left the ways she received the name of *Alexandre Bixio*.

Alton Ower.—On the 8th of July, Messrs. A. Leslie & Co., Hebburn, launched a steamer built to the order of Messrs. Adams & Co., Aberdeen. The dimensions are:—Length, 300 ft.; breadth, 36½ ft.; depth of hold, 30 ft.; carrying capacity, 2,500 tons; classed 100 A at Lloyd's; engines by the North-Eastern Engineering Company, Sunderland, 200 horse-power, nominal. She was named the *Alton Ower*, by Mrs. Adams. The vessel will be fitted up to convey live cattle on deck.

Steamtug.—On the 9th of July there was launched from the yard of Messrs. Wouldhave & Johnstone, at the Low Lights, North Shields, a *steamtug* of the following dimensions:—Length, 71 ft.; breadth, 16 ft.; and depth, 8 ft. The vessel will be fitted with engines of about 30 horse-power, by Mr. Marshall, engine builder, of South Shields, for whom the tug has been built. She will be employed for general purposes on the Tyne.

Orsino.—On the 10th of July an iron screw steamer built to the order of Messrs. Roberts & Preston, of Newcastle and Sunderland, was launched from the shipbuilding-yard of Mr. Robert Thompson jun., Southwick, Sunderland, her dimensions being as follows:—284 ft. long by 35 ft. broad, and 24 ft. 3 in. depth of hold; and has been built under Lloyd's special survey to class 100 A 1, and the personal superintendence of Mr. C. A. Bushell, Newcastle. Her engines, which are of 160-horse power, have been built by Mr. John Dickenson, Monkwearmouth, and are on the inverted direct-acting compound surface condensing principle. The vessel has two decks laid of iron, with full poop aft containing a cabin fitted up for the Captain and passengers, also bridge-house amidships with all the necessary accommodation for Officers and Engineers, and forecastle for Fishermen and Sailors; and is fitted throughout with all the latest improvements. She has also ample water ballast, four steam winches and donkey boilers by Messrs. J. W. & H. Wilson, Monkwearmouth; patent steam midship steering apparatus by Messrs. Donkin & C. Nicholl, Newcastle; patent screw gear aft Harfield's patent windlass, &c., &c. As the vessel left the ways she was christened the *Orsino*, by Messrs. Preston, of the Grange, Sunderland.

Blackhalls and *Lucinda*.—On July 10th, Messrs. W. Gray & Co. launched from their yard at West Hartlepool, two iron screw-steamers, of which the following are the principal particulars. The first, it is stated, has been built to the order of Messrs. Ropner & Co. Her dimensions are:—Length, 236 ft.; breadth, 31 ft. 6 in.; and depths of holds, 15 ft. and 19 ft.; gross tonnage, about 1,150 tons; will carry 1,400 tons on 15 ft.; classed 100 A 1; engines 110-horse power, by Messrs. T. Richardson & Sons, Hartlepool. As the new steamer left the ways she was christened the *Blackhalls*, after Blackhall Rocks, by Miss Evelyn Ropner, daughter of Major Ropner, the owner. The other vessel has been built to the order of Mr. F. Herskind, of West Hartlepool. Her dimensions are:—Length between perpendiculars, 256 ft. 6 in.; breadth, 34 ft. 6 in.; and depths of holds, 19 ft. 8 in. and 24 ft.; classed 100 A 1; engines, 150-horse power, by Messrs. Blair & Co., Stockton-on-Tees; gross tonnage, 1,750 tons; will carry a deadweight of 2,750 tons. She was christened the *Lucinda* by Miss Munro, of London.

Southwood.—On July 10th an iron screw-steamer was launched from the building-yard of Messrs. Richardson, Duck & Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length over all, 248 ft.; length between perpendiculars, 240 ft.; breadth, extreme, 35 ft.; depth of hold, 14 ft.; tonnage, O.M., 1,427 tons; gross tonnage, N.M., 1,304 tons. She has a long quarter-deck, bridge and topgallant forecastle, and is classed 100 A 1 at Lloyd's; will be rigged as a two-masted schooner. Her engines are on the compound principle, built by Messrs. Blair & Co., Limited, Stockton-on-Tees; they are of 120-horse power nominal, with cylinders of 30 in. and 55 in. diameter, 36 in. stroke, with a working pressure of 80 lb. She is also fitted with four steam winches and Messrs. Emerson, Walker & Co.'s patent windlass. She has a double bottom for water ballast capable of containing about 270 tons. The vessel has been built for Mr. David Wilson, J.P., of Hull. As she was leaving the ways she was christened the *Southwood* by Miss Harrison, of Hull.

Flying Dutchman.—On the 13th July there was launched from the iron shipbuilding-yard of Mr. J. T. Eltringham, Stone-quay, South Shields, an iron steamtug of the following dimensions:—Length, 100 ft.; breadth, 18 ft.; depth, 9 ft. 6 in. The steamer is built to the order of the Clyde Shipping Company, Glasgow, and as she left the ways she was named the *Flying Dutchman*. The engines have been built by Mr. Rennoldson, South Shields, and they are 60-horse power nominal. The vessel has been built under the inspection of Mr. R. Blair, engineer superintendent of the company.

North Durham.—On the 14th July an iron screw steamer, built to the order of Messrs. Hugh Roberts & Son, of Newcastle, was launched from the shipbuilding-yard of Messrs. Palmer & Co., Jarrow. Her dimensions are as follows:—265 ft. long, 35 ft. broad, and 24 ft. 9 in. depth of hold; to carry about 2,700 tons. She has been built under special survey, to class 100 A 1 at Lloyd's, with water ballast tanks from stem to stern on the new longitudinal principle of cellular construction, forming a double bottom throughout the whole length of the hull; has full poop, deck houses, and topgallant forecastle, Messrs. Donkin & Nicholls' patent steam steering gear amidships, and will be fitted throughout with all the latest improvements. Her engines are on the inverted direct-acting compound surface-condensing principle, 180-horse power. As she left the ways she was christened the *North Durham* by Mrs. Roberts, wife of the Managing Owner.

Mutine.—On July 20th another composite sloop was added to the Navy by the launch at Devonport of the *Mutine*, 600-horse power, 120 ft. long, 36 ft. beam. 1,124 tons displacement (when completed). She will carry six guns, and will be extremely useful for river and coast work. Lady Elliot, wife of the Admiral Commanding-in-Chief at Devonport, performed the ceremony of christening. The engines are the work of Messrs. Maudeslay, Field & Co.

On the 25th June there was launched from the building-yard of Messrs. Grendon & Co., at Drogheda, a screw steam yacht. Her framing and plates are all of steel. Length 62 ft., beam 9 ft. 6 in.; She is fitted with two diagonal engines of 40-horse power and horizontal steel boilers, and was built to the order of Colonel W. S. Cooper, Dee Bank, Chester. She is estimated to attain 16 to 17 knots per hour.

Duchess of Edinburgh.—A large steel paddlewheel steamer, named the *Duchess of Edinburgh*, was launched July 21st from the yard of Messrs. J. & Geo. Thomson, Clyde Bank Foundry, Glasgow, for the Folkestone and Boulogne service of the South Eastern Railway. In general appearance and dimensions the new vessel is similar to the *Albert Victoria*, which has just been added to the Company's fleet, but she is engined on the compound principle for the purpose of enabling her to develope a very high power of speed. Her length is 250 ft., 29 ft. 6 in. beam, and depth of hold 14 ft. 2½ in.; the boilers will be steel, and she is fitted under Lloyd's special survey with patent feathering paddles, steam steering gear winches, and windlasses. The internal decorations and conveniences are of an elaborate character. The christening ceremony was performed by the Hon. Mrs. James Byng, wife of the Deputy Chairman of the South Eastern Company, in the presence of a large company.

Wearmouth (*s.s.*)—This vessel was successfully launched from Messrs. Short Brothers' yard, Sunderland, June 30th, 1880, and was gracefully christened the *Wearmouth* by Miss Barwick, daughter of Mr. J. S. Barwick, the owner. This is the tenth vessel built by Messrs. Short for the same owner. She is 260 ft. long, and 36 ft. beam, and 19½ ft. deep, has a long raised quarter deck and short poop, also top-gallant forecastle, dead weight ability 2250 tons. She is built on the "longitudinal bracket" principle, and has a double bottom all fore and aft. Has six water-tight bulkheads, patent steam steering gear (Simey's), Harfield's patent windlass, and four powerful steam winches. The engines and boilers are being made by Mr. J. Dickinson, of Sunderland. The vessel is built to the highest class in the Liverpool Registry, and has several additions above their requirements, and is also under the superintendence of Mr. Joseph R. Oldham, of Sunderland.

Berry Castle.—On the 22nd of July the iron river steamer *Berry Castle*, built for the Dartmouth and Torbay Steam Packet Company, was launched from the yard of Messrs. Polyblank & Company, at Kingswear, Dartmouth. The new steamer measures 112 ft. over all, with a beam of 14 ft., and a draught of 2 ft. 6 in. She is a paddle-boat, and is fitted with a pair of compound high-pressure surface-condensing oscillating engines of 38 (nominal) horse power, the side valves working on a new principle of perfect equilibrium. The boat is intended for passenger traffic between Dartmouth and Totnes, on the Dart, and it is estimated that she will do the distance—about 12 miles—in 45 minutes. The ceremony of christening was performed by Lady Seale, Sir Henry Seale, Bart. (Mayor of Dartmouth), being also present.

Liscard.—On the 22nd of July there was launched from the iron shipbuilding-yard of Messrs. T. & W. Smith, the Limekiln Shore, North Shields, a screw steamer of the following dimensions:—Length, 285 ft.; over all, 295 ft.; breadth, 35 ft.; depth, 24 ft. The vessel will be fitted with engines of 180-horse power by Messrs. Hawthorn & Co., Newcastle. She is classed 100 A 1 at Lloyd's and will carry 3,000 tons. The steamer will also have a limited accommodation for passengers. The *Liscard* has been built to the order of Messrs. Arthur Holland & Co., London, and will be engaged in the Atlantic trade. Mrs. M'Millan, wife of the Captain of the *Liscard*, christened the vessel.

Alicia.—On July 22nd, Messrs. Edward, Withy & Co. launched from Middleton Ship-yard, West Hartlepool, an iron screw steamer, built to the order of Messrs. Middleton & Co., West Hartlepool, under the superintendence of Captain Dew. This vessel is No. 89 in the builder's yard, has large capacity both for dead weight and measurement cargoes, and is intended for the Indian Transatlantic, and Mediterranean trades. Her principal dimensions are:—Length, b.p., 245 ft. 8 in.; extreme beam, 33 ft.; depth of hold to Lloyd's height of floor plates, 18 ft. She has a double bottom all fore and aft, on the "longitudinal and bracket system," and has been built under Lloyd's special survey for the 100 A 1 class; has topgallant forecastle, long full poop, and bridge-house joined. She is fitted with Napier's patent steam capstan windlass, and has the chart-house, engine-room, and cabin skylights, companions, rails, and decks constructed of iron. This steamer, like the new *Alverton* (s), lately built by Messrs. Whitby & Co., for the same owners, is provided with a bath in the forecastle for the crew, and many other improvements. Engines of 120-horse power will be fitted by Messrs. Blair & Co., of Stockton-on-Tees, and the rig will be that of a topsail schooner. She will be commanded by Captain R. B. Williams, of Chester, who holds an Extra-Master's certificate. As the steamer left the ways she was christened *Alicia* after the wife of one of the Owners, by Miss Middleton, of Thirsk.

Louise Dagmar.—The *Louise Dagmar*, intended for the Folkestone and Boulogne service of the South-Eastern Railway Company was launched on July 24th at the building-yard of Messrs. Samuda Brothers, Poplar. The *Louise Dagmar* is 250 ft. in length, 29 ft. beam, and 1000 tons burden. She is a sister vessel, and similar in all respects to the *Albert Victor*, which was launched from the same yard on the 25th May last, and the very successful trials of which have since been noticed. The *Louise Dagmar* is also built of steel, made by the Siemen's process, and thus a considerable reduction in weight of hull has been secured, while retaining even greater strength of structure than iron would have given. A peculiarity which trials of the sister ship have shown is, that while steel is more ductile than iron, it nevertheless gives additional rigidity to the structure, and no movement whatever is communicated to the ship, even when the engines are driving it 18 knots an hour through the water. Another remarkable fact noticed in the trials of the *Albert Victor* is that the length of vessel (250 ft.) and the great speed appear almost entirely to overcome the motion of the vessel in a sea-way that with a smaller vessel and less speed would be material. These are some of the advantages that will result from the adoption of these improved larger and faster vessels to passengers travelling between Folkestone and Boulogne. The engines, 2,800 indicated horse power, are a facsimile of the sister ship, and are made by the same firm, Messrs. John Penn & Son, of Greenwich. The ceremony of launching was performed by Lady Watkin, in the presence of a large number of visitors (about 100 in all), amongst whom were Sir Edward Watkin, Sir Henry Tufton, Bart., Miss Samuda, Mr. and Mrs. Watkin, Colonel and Mrs. Ward, Mr. Henry Green, Mr. and Mrs. John Shaw, Mr. M. Fenton, Mr. Earnshaw, Mr. Pope, Q.C., and others. After the launch the visitors were entertained at lunch, at which Mr. J. D'A. Samuda presided, and proposed "Success to the *Louise Dagmar*," which was responded to by Sir E. Watkin, who expressed his regret that Parliament had been deprived of the services of Mr. Samuda, whose opinion on naval matters was always listened to with the greatest respect. The toast of "The South-Eastern Railway," was responded to by Sir Henry Tufton, Bart., one of the directors, who, referring to the proposed tunnel between Dover and Calais, expressed an opinion that, though it might be an engineering possibility, it would never be a commercial success.

THERE was launched from Torpedo Wharf, Wandsworth, last month, J. Long's Patent Atmospheric Unsinkable Steam Lifeboat, which we anticipate will make a complete revolution in the existing form of lifeboat. In our next number we propose giving full description with illustration of the same.

LAUNCHES.—SCOTCH.

Fair Geraldine.—On the 21st June there was launched at Leith, from the shipbuilding-yard of Messrs. Ramage & Ferguson, a steam yacht, built to the order of the Right Hon. Lord Otho Fitzgerald, of Carlton-house-terrace, London. The dimensions are:—Length, 143 ft.; breadth, 21 ft.; depth, 12 ft.; tonnage, 300 tons. She will have engines of 60-horse power, fitted with all the latest improvements. The speed expected is 11½ knots. The ceremony of naming the vessel *Fair Geraldine* was performed by Miss Seator, of Bonnington-house, Edinburgh.

Pearl.—On the 22nd June Messrs. William Hamilton & Co. launched, at Port Glasgow, an iron screw-steamer of the following dimensions:—Length, 144 ft.; breadth of beam, 21 ft. 6 in.; depth of hold, 12 ft.; and about 317 tons. The engines, to be supplied by Messrs. Fleming and Ferguson, Paisley, will be compound surface-condensing, direct-acting, and of 65-horse power nominal. The new steamer, which is named the *Pearl*, has been built for Messrs. James Hay & Sons, Buchanan-street, Glasgow, and is to be engaged in the Irish coasting trade.

Spey.—On June 22nd a steamer, built by Messrs. Gourlay Brothers to the order of Messrs. George Armitstead & Co., was launched from the Camperdown Shipyard, Dundee. Miss Winifred White gracefully christened the vessel the *Spey*. The new steamer is 218 ft. long, 29½ ft. in breadth, with a depth of hold of 15½ ft.; she is 1,005 tons gross, and has been registered in the highest class at Lloyd's. Engines of 100-horse power will be fitted on board, and the vessel is to be provided with all the latest improvements for the rapid loading and discharge of cargo. Captain Isaac Donald has been appointed to the command of the *Spey*, which is to be employed in the Baltic, Archangel, and Mediterranean trades.

Catarina.—On the 24th June there was launched from the iron shipbuilding-yard of Messrs. Robert Steele & Co., Greenock, a screw steam yacht of the following dimensions:—Length, 186 ft.; breadth, 126 ft.; depth, 15 ft.; and a registered tonnage of about 600 tons. She will be supplied with engines of 110-horse power. This yacht has been built to the order of James Houldsworth, Esq., of Coltness, and on leaving the ways was named the *Catarina*. She will be commanded by Captain Rice.

Foxhound.—On the 24th June, Messrs. Robert Duncan & Co., launched at Port Glasgow a screw steamship of the following dimensions:—Length, 155 ft.; breadth of beam, 22½ ft.; depth of hold, 11 ft.; and about 380 gross tonnage. This steamer is a duplicate of the *Greyhound*, launched in May, for Messrs. Robert Thompson & Co., London, and is for the same owners. She has been named the *Foxhound*, and is for the continental and coasting trade. Like the *Greyhound*, she is classed 100 A 1 at Lloyd's, is fitted with water-ballast, and has a double bottom. The *Foxhound* will be engined by Messrs. Smith Brothers.

Ardanbhan.—On the 24th June Messrs. Henry Murray & Co. launched at Port Glasgow an iron screw steamer, similar in build to the steamer *Ardandhu*, launched by them in December last. The new steamer is named the *Ardanbhan*, and is of the following dimensions:—Length, 225 ft.; breadth of beam, 31 ft.; depth of hold, 17 ft.; and about 1,200 tons register. This steamer has been built to the order of Messrs. M'Laren, Crum & Co., Glasgow, and is for Spanish ore and nut trade. Messrs. William King & Co., Glasgow, will supply the engines, of 110-horse power nominal.

Countess of Cromertie. — On June 24th, a steamer named the *Countess of Cromertie* was launched from the Caledon shipyard, Dundee. The steamer, built by Mr. W. B. Thompson to the order of Messrs. James Allison & Sons, Dundee, is 760 tons gross, and classed 100 A1 at Lloyd's; she is 202 ft. long, 27 ft. in breadth, and 14½ ft. deep in the hold. She will be fitted with engines of 90-horse power. Captain Allan, formerly of the barque *Lintrathen*, has been appointed to the command of the new steamer. The christening ceremony was performed by Miss Hynd, daughter of one of the owners.

Kléber.—Messrs. Caird & Co. have launched from their shipbuilding-yard at Greenock, an iron screw steamer of the following dimensions:—Length over all, 322 ft. 2½ in.; length of keel and forerake, 312 ft.; length on load water-line, 312 ft.; beam (moulded), 33 ft. 6 in.; depth (moulded), 25 ft. 6 in.; depth of hold, 24 ft. 6¾ in; registered tonnage, about 3000 tons. As she left the ways she was named the *Kléber*, and has been built to the order of the French Générale Transatlantique Compagnie, for whom several steamers have already been launched on the Clyde.

Carlo.—On the 6th July, Messrs. Alex. Stephen & Sons launched from their building-yard at Linthouse, Govan, an iron-screw steamer of about 1300 tons, classed 100 A 1, under special survey, designed for carrying heavy cargoes on a small draught of water, constructed with double bottom for water ballast on the bracket principle, and fitted before launching with compound surface condensing engines of 130-horse power nominal. This vessel which was named the *Carlo* has been built for Messrs. Tellefsen, Wills & Co., Cardiff, and will be commanded by Captain Williams.

Jasper.—On the 6th July, Messrs. T. B. Seath & Co. launched from their shipbuilding-yard at Rutherglen, an iron screw steamer of about 280 tons burthen, and of the highest class at Lloyd's, which has been built to the order of Mr. Wm. Robertson, Glasgow, for coast and general traffic. The ceremony of naming her *Jasper* was performed by Miss Stewart, of Glasgow. The *Jasper* is to be fitted with machinery, embracing a pair of surface-condensing engines of 60-horse power by Messrs. Wm. King & Co., of Glasgow.

Steel Arrow.—On the 10th July Messrs. Dobie & Co. launched from Govan Shipbuilding-yard a steel screw steamer of about 1,100 tons register, which was named *Steel Arrow* by Miss Sprott, of Shefton Park, Liverpool. After having traversed the launching ways about 100 ft., the progress of the vessel became arrested, necessitating the opening up of the ways for the purpose of greasing anew. This having been satisfactorily accomplished early on the 12th, the vessel slipped into the Clyde in perfect order.

City of Brussels.—On the 14th of July Mr. Robert Chambers, jun., shipbuilder, launched from his yard at Dumbarton a vessel named the *City of Brussels*, of 500 tons deadweight. Her dimensions are:—Length, 140 ft. over all; breadth, 22½ ft.; and depth of hold, 11 ft. She will be classed 100 A 1 at Lloyd's. The vessel in question has a straight stem and eliptic stern. She has also a raised quarter-deck extending over the engine and boiler-space, and passenger accommodation in house on deck. She is fore-and-aft schooner-rigged, has been built to the order of Messrs. Thomas & Co., Shipowners, London, and is intended for the London and Brussels trade. She will be supplied with compound surface-condensing engines of 350-horse power by Messrs. Kincaid, Donald, & Co., engineers, Greenock. On leaving the ways the vessel received its name from Mrs. Groome, of London, wife of the representative of the Owners.

Duchess of Edinburgh.—On the 23rd July a steel paddle-wheel steamer, named the *Duchess of Edinburgh*, was launched from the yard of Messrs. J. & George Thomson, Clyde Bank Foundry, Glasgow, for the Folkestone and Boulogne service of the South-Eastern Railway. In general appearance and dimensions the new vessel is similar to the *Albert Victoria*, which has just been added to the company's fleet, but she is engined on the compound principle for the purpose of enabling her to develope a very high power of speed. Her length is 250 ft., 29 ft. 6 in. beam, and depth of hold 14 ft. 2½ in.; the boilers will be of steel, and she is fitted under Lloyd's special survey with patent feathering paddles, steam steering gear winches, and windlasses. The christening ceremony was performed by the Hon. Mrs. James Byng, wife of the Deputy Chairman of the South-Eastern Company.

TRIAL TRIPS.

The Abd-el-Kader.—The trial trip of this steamer, built by Messrs. John Elder & Co. for the Compagnie Générale Transatlantique of France, took place on the 26th June. The French company gave orders for 16 new screw steamers about seven months ago, and ten of these came to the Clyde, Messrs. Elder & Co. being entrusted with four. The *Abd-el-Kader* is the third already delivered over to the company by the firm. The new vessel is in every way similar in construction to those already completed, her length between perpendiculars being 313 ft. 6 in., breadth, 33 ft. 6 in., depth (moulded), 25 ft. 6 in., with a gross tonnage of 1,850. The engines are on the compound principle, with inverted cylinders and surface condensers. The high pressure cylinder is 42 in. diameter, and the low pressure 80 in., with a 4 ft. stroke. Steam is supplied by two circular double-ended boilers of 14 ft. diameter and 18 ft. long, with 12 furnaces. The boilers are constructed for a working pressure of 75 lb. per sq. in. Accommodation is provided for 60 first, 40 second, and 60 third-class passengers, besides the ship's complement of officers and men 50 all told. The vessel is fitted up with powerful screw-steering gear aft, and also steam-steering gear on the bridge and amidships, steam windlass, three powerful steam winches with hold pumps attached, fresh water condensers, centrifugal pumps for the holds, and all the most improved appliances for navigating the vessel with ease and safety. After adjusting compasses in the Gareloch, the new vessel proceeded down to Skelmorlie, where the measured mile was run four times with the following result:—First run (down), 3 min. 56 sec., equal to 15·254 knots per hour; second run (up) 3 min. 48 sec., equal to 15·789; third run (down), 3 min. 50 sec., equal to 15·652; fourth run (up), 3 min. 51 sec., equal to 15·584, giving a true mean speed of 15·596 knots over the entire trial. The guaranteed horse power of the engines is 2,100, but during the trial they indicated over 2,600. The vessel afterwards ran the lights, obtaining a speed of 15·5 knots.

The Albert Victor.—On the 29th June the trial trip of this paddlewheel passenger steamer took place on the Maplin. She has been built by Samuda Brothers for the South-Eastern Railway Company, for service between Folkestone and Boulogne. The length of the vessel is 250 ft., breadth 29 ft., depth 15 ft. 6 in., and tonnage (B.M.) 1,040 tons. The engines, with oscillating cylinders, are of 2,800-horse power, and were manufactured by Messrs. J. Penn & Sons, of Greenwich. The vessel is built of steel. The result of the trial trip both as regards the vessel and the engines was entirely satisfactory. Her speed on the measured mile on the Maplin was as follows:—First mile, 20·339 knots per hour; second mile, 17·143 knots per hour; third mile, 20·445 knots per hour; fourth mile, 16·590 knots per hour; fifth mile, 19·890 knots per hour; and sixth mile, 17·561 knots per hour, giving a mean speed of 18·585 knots or nautical miles, equal to 21½ statute miles per hour.

Lily and Violet.—The London and North Western Railway Company's new express steamers *Lily* and *Violet*, lately built by Messrs. Laird Brothers, commenced the new service from Holyhead to North-wall, Dublin, on the 1st of July. On their trial trips they attained a speed of about 18 knots with 3,000-horse power.

The Premier.—This screw-steamer, recently built by Messrs. Raylton Dixon & Co., of which Messrs. Edward Harris & Co., of Middlesborough, are the managing owners, proceeded on her trial trip on the 1st July. This vessel, which is the sixth built by her constructors for this firm, is a vessel of 733 tons gross register, being 180 ft. long by 30 ft. beam by 13 ft. 11 in. depth of hold; she has a long raised quarter deck, as well as main deck of iron, water ballast in fore and after holds, three steam winches on deck, and engines of 80-horse power nominal by Messrs. Blair & Co. (Lim.), of Stockton. She will carry about 960 tons on the light draught of 14 ft., and is specially adapted for the ore trade. The steamer proceeded to sea, and a very satisfactory run was made, after which she returned to the dock.

Neptune.—On the 8th of July this tug boat, built by Messrs. Lewis & Co., Blackwall Point, and engined by Messrs. Alexander Wilson & Co., Vauxhall Iron Works, Wandsworth Road, S.W., had a trial trip on the measured mile at Long Reach. The engines are high pressure, of 30-horse power nominal, have two cylinders 12 in. diameter, 14 in. stroke, and are fitted with an improved feed heating apparatus, which can also be used as a condenser when required. The engines worked most satisfactorily during the day, a mean speed of 9·6 knots per hour being attained with and against tide. The dimensions are:—Length, 62 ft. 4 in.; beam, 13 ft. 6 in.; depth, 6 ft. 11 in.; and it is intended for towing barges on the Thames from the docks upwards. The *Neptune* is a sister vessel to the *Sunbeam*, and has been supplied by the same builders and engineers to the order of George Doo, Esq., Horseshoe Wharf, London Bridge.

Gallego.—On the 2nd July, a trial of the *Gallego* (s) and her machinery was made, which was highly satisfactory to all on board. She was launched about six weeks ago from the shipbuilding yard of Mr. Robert Thompson, junior, Southwick, having been built to the order of Messrs. John Glynn & Son, Liverpool, specially for their trade. Her principal dimensions are:—Length, 330 ft.; breadth, 36 ft.; depth, 25 ft. 6 in.; her gross tonnage being 2,630. She has been built under Lloyd's special survey to class 100 A 1, and is fitted with all the most recent improvements, including iron decks covered with wood, ample water ballast, fresh water condenser, steam steering gear, four steam winches and large horizontal donkey boiler, screw steering gear aft, Baxter Harfield's patent windlass, also the most approved system of ventilation. The machinery, which has been fitted by Mr. George Clark, Southwick (of 350 nominal horse power), during construction under the superintendence of Messrs. G. & A. Hepburn, of Liverpool and Newcastle, ran with the greatest smoothness, making 58 to 60 revolutions per minute, with a working pressure of 78 lbs., and the mean speed attained being 12½ knots per hour.

Ville de Barcelone.—On July 3 the *Ville de Barcelone*, which has just been completed for the Algerian mail service of the Compagnie Générale Transatlantique, by Messrs. Caird & Co., of Greenock, after having her compasses adjusted at the Gareloch, went down the river and was subjected to a series of speed trials. The speed attained was greatly in excess of the contract. The vessel was loaded to 15 ft. 9 in. The measured mile was run four times with the following results:—1st run, 3 min. 57 sec.—speed 15·189 knots; 2nd run, 3 min. 58 sec—speed, 15·127 knots; 3rd run, 3 min. 57 sec.—speed, 14·189 knots; 4th run, 3 min. 53 sec.—speed, 15·450 knots. Main speed, 15·238 knots per hour. The *Ville de Barcelone* was then run to the Cloch Lighthouse, and put on the Cloch and Cumbrae trial, with the following results: Cloch to Cumbrae, 53 min.; Cumbrae to Cloch, 54 min.; mean speed, 15·319 knots per hour. The engines worked without the least hitch. The indicated power on the trials was 2,320 horses, and the revolutions 69. The vessel left the Tail of the Bank for Marseilles at 9 p.m. without dropping anchor.

The Brinkburn.—On July 10 a trial was made with the iron screw-steamer *Brinkburn*, built by Messrs. Swan & Hunter, of Wallsend, for Messrs. Robert Bell & Co., of Blyth. The dimensions of the steamer are as follows:—Length, 280 ft. between perpendiculars; breadth, 34 ft. 9 in.; and depth of hold, 24 ft. 6 in. The vessel is fitted with all recent improvements. She is built to the highest class at Lloyd's; the engines are by the firm of Messrs. R. & W. Hawthorn, of Newcastle, having cylinders 32 in. and 62 in. diameter, with a stroke of 42 in., and indicating on trial 950-horse power. The vessel left the Tyne about mid-day. Her engines worked remarkably well, and the vessel attained a speed of 11½ knots on the measured mile. She is on the same lines as the *Bothal* (*s*), which was also built by Messrs. Swan & Hunter for the same firm.

Spey.—On June 10 the steamer *Spey*, recently launched by Messrs. Gourlay Brothers & Co., Dundee, for Messrs. George Armitstead & Co., went down the river on her trial trip, a large party being on board. The result was highly satisfactory, and the vessel sailed for Archangel in the evening.

The Red Rose.—On the 13th of July, the steamer *Red Rose*, recently launched by Messrs. Schlesinger, Davis & Co., Wallsend for Captain Peter Rowe, of Cardiff, had a satisfactory trial trip. *The Red Rose* is 240 ft. in length, 32 ft. 2 in. beam, and 18 ft. 9 in. of hold, and classes 100 A 1 at Lloyd's. Captain Deslanders takes command of the vessel. The engines are by Messrs. Hawks, Crawshay, & Sons, of Gateshead, and are of 130-horse power, with cylinders 28 in. and 53 in. diameter, each having a stroke of 36 in. The vessel's engines were thoroughly tried, and everything worked exceedingly well, a main speed of 10 knots being obtained, although the propeller was only partially immersed, and a rough sea running.

The Gitano.—On the 15th of July the new steel steamer *Gitano*, built by Earle's Shipbuilding and Engineering Company, at Hull, was taken out for her official trial. *The Gitano* is 240 ft. long, and will carry about 1,700 tons of dead weight, and is intended for the Baltic trade; but the feature of special interest in her construction is that she is built entirely of Siemen's steel, and is the first ocean-going steamer built in this neighbourhood of that material. Her boilers are also of steel. The engines of the *Gitano* are compound surface-condensing, 120 nominal horse power, and developed at full speed about 750-horse power. They are on the single crank principle. The ship was run at three-quarter power from the Newsand Float to Hull, a distance of 27 miles, in slack water, and gave a mean speed of 10 knots per hour.

The Adeline Schull.—On July 17th this steamer lately launched by Messrs. H. M'Intyre & Co., Paisley, went down the river on her trial trip. The *Adeline Schull* is an iron screw steamer of 600 tons, built to the highest class at Lloyd's, and fitted with all the latest improvements both in hull and machinery. Her owners are Messrs. Kalekhoff & Schoeller, Antwerp, who intend the vessel for the London and Antwerp trade. The engines, which are on the compound surface-condensing principle, have been fitted on board by Messrs. Fleming and Ferguson, Phœnix Engine Works, Paisley. The vessel attained a speed of 12 knots, being 1½ knot over the guaranteed speed.

The Adelaide.—The Great Eastern Railway Company's new steel paddle steamer, built by the Barrow Shipbuilding Company, on her trip round from Barrow, ran a distance of 100 knots at an average speed of 14·56 knots per hour, which, considering she had a cargo of nearly 250 tons of coal on board, shows her to be a fast vessel. Her passenger accommodation is similar to that supplied to the Atlantic liners built by the same company. Her length is 260 ft., her beam 32 ft., and her engines will develope about 2,000-horse power.

Wearmouth (*s.s.*)—This vessel had a trial trip on Saturday, July 17th, 1880, in the neighbourhood of the rivers Wear and Tyne. The engines worked up to 73 revolutions with nearly 80 lb. of steam, and the average speed of ship was a little over 10 knots an hour. The cylinders are 33in. and 62in. by 42in. stroke, by John Dickinson, of Sunderland. Two circular single end boilers with three furnaces in each. The trial lasted from nine in the morning till six at night, and the engines and boilers gave every satisfaction during the whole trial, so that the vessel was able to proceed on her first voyage at once. The owner is Mr. J. S. Barwick, of Sunderland, and she has been built under the superintendence of Mr. Joseph R. Oldham, Consulting Engineer.

TWO NEW second-class torpedo boats, numbered respectively 64 and 65, built by Messrs. Thorneycroft & Co., of Chiswick, were tried in Stokes Bay on July 15th and 16th, when the extraordinary mean speed of 17·3 and 17·64 knots were realized on the mile, which is about equal to the speed which has been obtained from the first-class or Lightning class. The guaranteed or contract rate is 15½ knots, but, in order that the utmost rapidity might be got out of these small craft, the Admiralty have covenanted to pay the manufacturers £200 for every quarter knot which can be realized above the contract. As one boat made one knot and a half and the other two knots an hour in excess, the Messrs. Thorneycroft have thus earned £2,800 in premiums, and as they have contracted to furnish ten boats of a similar kind and under similar conditions, the arrangement will prove exceedingly lucrative. In order that this extreme speed may be acquired it is not considered absolutely necessary that the engineers and stokers should be weighed like horse jockeys, but the boats are handicapped to such a nicety that on the trial two tons was held to be the maximum of weight to be carried.

The Adelaide.—A steamship of steel, built for the Rotterdam service of the Great Eastern Railway by the Barrow Shipbuilding Company, started on her first voyage on Friday night from Harwich to Rotterdam. It is not a great many years since the trade between Holland and the port of Harwich was carried on, so far as this company was concerned, with two or three small vessels; but as the service grew in public favour the number of steamers employed by the company had to be increased year by year, until, in 1879, the company had a little fleet of seven ships. Early in the present year a steamer of a new type, the *Lady Tyler*, was put on the line, and the company were then enabled, in addition to their daily steamers to and from Rotterdam, to run a steamer four times a week to Antwerp. While the comfort of travellers has not been overlooked, the carrying trade, of provisions particularly, has been greatly increased. Thus, for instance, 8,000 tons of dead meat, 6,000 tons of butter, about the same quantity of cheese, and some 5,000 tons of eggs were brought over last year. It may be of interest to some to know that most of these eggs come from Italy. They are collected from the farmers by Signor Cirio at Verona, and thence by a six or seven days' journey are sent to London. The fruit trade is one which has also benefitted much by the facilities offered to business men by this company, for, supposing that the market in London should be overstocked, the merchant can in the afternoon telegraph to Rotterdam to his shippers to send the consignment, then already on board one of the company's steamers, to Manchester, or Birmingham, or Liverpool, instead of to London, and the consignment will on arrival at Harwich be sent to the midland or northern town direct, instead of to the metropolis. With a view to provide accommodation for the rapidly increasing traffic between the Low Countries and Harwich, the company have also undertaken extensive works at Ray Island, on the right bank of the Stour, about a mile above the town. Here they are making a quay 600 yards in length, with 18 ft. of water for vessels lying alongside, and on land there will be siding-room for 800 trucks, a passenger station, goods-sheds, Custom-house and all necessary offices, and cattle pens for the reception of live stock from Denmark. The new ship, the *Adelaide*, has been designed to meet a special requirement of the Rotterdam service. The sand bar at the entrance to the Hook leaves only about 11 ft. of water at low tide, and as the service of the company is constant and regular, a vessel must be able when loaded with cargo, to enter the harbour. The *Adelaide*, while affording ample accommodation for passengers, and with 300 tons of cargo on board, still draws but 9 ft. 8 in. She is 260 ft. in length, of 32 ft. beam, and 14 ft. 3 in. in depth. With a registered tonnage of 969, she is certified to carry 181 first class and 248 second class passengers. In a house on the poop deck are four cabins, such as on Atlantic steamers would be called "state-rooms." On what should be called the upper deck is the large dining saloon, handsomely lined with rose and olive wood. Adjoining are other state rooms, those on the port side, which are reserved for ladies, opening into the ladies' saloon. Below, the main deck, still above the water-line, is fitted with sleeping cabins and berths, which are ventilated by cowls placed on the upper deck. Forward are rooms for second class passengers, differing but little except in beauty of finish and upholstery from those provided for the travellers by the first class. The new ship, which is commanded by Captain F. Lawrence, made a run on Friday afternoon as far as the Shipwash Light, nearly 17 miles, and back, when among the party on board were Mr. Gooday, the continental traffic manager; Mr. Bromley, engineering superintendent; and Captain Howard, marine superintendent of the company. For a part of the time, the engines developing about 2,000 horse power, the steamer made 16 knots an hour, and she maintained a speed of over 14 knots an hour throughout the trip. The engines, constructed by the Barrow Shipbuilding Company, are compound oscillators of 6 ft. stroke, the high-pressure cylinder being 45 in. and the low-pressure cylinder 87 in. in diameter. The greatest number of evolutions per minute was 37, with 75 lb. pressure and steam vacuum 26 in. In addition to a small boat for ordinary use, there are four large boats fitted with Hill and Clark's patent boat-lowering apparatus, by which the boat, when let down into the water, is not detached until entirely water-borne; and, as a further provision against disaster, an arrangement known as Wood's patent self-adjusting rivet-hole and leak-stopper is carried. With this, one or more circular shields of wrought iron, with a thick wad or backing of felt, can be lamped over any hole made in the ship's side.

THE ALBERT VICTOR.

This ship was on July 3rd taken by Mr. Samuda, her builder, and Messrs. J. & W. Penn, the makers of her engines, from Gravesend to Folkestone, where she will at once begin her career as one of the South-Eastern Company's passenger boats across the Channel to Boulogne. *The Albert Victor* steaming against a strong head wind, took only three hours and 45 minutes on the run from Gravesend to Folkestone, a distance of 84 miles, her prodigious speed, steadiness, and freedom from vibration exciting the special admiration of Mr. E. J. Reed, M.P., who, with Mr. Norwood, M.P., several directors and officials of the South-Eastern Railway, and a party of friends, had been invited to take part in the trip. At the luncheon which was given on board during the sail round Mr. Samuda stated that 20 years previously his firm and that of Messrs. J. Penn & Son had at the request of the company, turned out the *Victoria*, only 200 ft. long and of 7 ft. draught, yet steaming upwards of 16 knots per hour—a speed under the conditions at that time unprecedented. Now the *Albert Victor*, with only 50 ft. additional length, but steel built and with oscillating engines developing 2,800 indicated horse power, accomplished 18½ knots and was about the fastest thing afloat. Mr. Penn also made some striking remarks about the engines, which were not compounded, and therefore not the most economical of coal, but which for driving power and results in speed put to the very best possible use the saving in weight and the improvement in her lines obtained by the use of steel in the fabric of the ship. This saving in the case of the *Albert Victor* is about 130 tons. Messrs. Samuda & Penn, with their guests, starting from Charing-cross station by special train at 11 a.m., were back there at 6.45 p.m., having in the interval made the round from Gravesend to Folkestone, with more than one cause of detention. They were half-an-hour behind the time fixed in the programme, but it was a very fast and pleasant run.

THE STEEL YACHT "VANDUARA."

A DISCUSSION was started lately relative to the advantages and disadvantages of steel as compared with copper-sheathed wood in yacht building. At the time the *Vanduara*, the steel boat had not met the *Samœna*, the newest, and undoubtedly the fastest, of first-class wooden cutters, in a fair trial. This has now been had, and the result has proved the steel boat peerless. It would be wrong, however, to Mr. Watson to say that the success of his boat has to be attributed to the material used. Any one who has seen the wooden boats designed by him—the 10-tonner *Madge*, and the 5-tonner *Nora*, the fastest boats of their class—knows that the result would probably have been the same whether the *Vanduara* had been built of steel or of wood. Steel, however, has its advantages, one of which, and a very important one, is that you can build a boat a little cheaper than in the old style. In the hull you can get your ballast deeper down than in a wooden vessel, and consequently with a lower centre of gravity you get a boat to stand better up to her canvas. In the *Vanduara* the lead has in a molten condition been run right into that part of her which in other boats would be called the keel. The whole of the lower part of the vessel, therefore, consists of solid lead, cased in steel. The ballast being stowed low down, there is an increase in head room, while from the thinness of the steel plates there is more accommodation than is to be found in a wooden ship of the same size. The disadvantages are a tendency to foul, for nothing has yet been found for ships' bottoms so effective in keeping the hull clean as copper. There is possibly another advantage which a steel boat possesses, and this is its pliancy or litheness. It is well-known that the old sailors used to like "limber" boats, and in order to make them so some of the timbers were sawn half through. Leaving aside the question as to whether the yacht of the future is to be built of wood or of steel, Mr. Watson has decided that you can race a cutter of 90 tons every day, and yet enjoy all the comforts of quiet cruising. In no race was a single article of the furniture removed from its place, nor was a yard of canvas allowed to lie in the cabin. This is an advantage which those who have had to eat a hasty lunch on a bundle of wet sails in any of the crack old wooden boats will appreciate. As to the *Vanduara*, when her plans are made public, those who have been clever enough to see what a grand copywork of good points of other boats she is—the bow of *Jullanar*, &c., with the stern of *Miranda*—will be the first to admit that she is a daring departure from all old designs."

Reviews.

Patent Law and Practice (enlarged edition). By A. V. Newton. Published by Trübner & Co., 57 and 59, Ludgate Hill.

This very excellent little work is full of the best information and advice to patentees. These, as a body, are far too apt to imagine that when they have obtained the formal parchment and great seal for their invention that they have got all they require and of the best quality. They have but to glance through such a book as this to see that the preparation of a specification to give a trustworthy claim to any invention, is a much more difficult matter than they would imagine.

They will see from chapters I., II., and III. that although patents are freely granted to all by the Crown, they may not be worth the paper they are written on by reason of prior publication, wrong choice of title, or inapplicability of the inventor's idea to the privilege of protection.

Then chapters IV. and V. will show them that they are liable, at the notice to proceed, or other successive stage, to legal actions by opposing parties, for opposition or infringement, when the only possibility of their patent remaining a property at all will depend, in the first place, upon the careful legal preparation of their specifications, and in the second place possibly upon the adroit use of disclaimers. The final specification has, from its importance, received a special chapter to itself, and the extensions of patents and the rights conferred on patentees have received due attention and explanation. In the last chapter of the book on patent agents, we can fully concur in the conclusions pointed out that, although the profession of patent agent is an open one without diploma, the requirements of legal and general practical and technical knowledge are so large, that those properly qualified for the task are few, and that it should behove patentees to use the greatest caution in their selection of an agent.

Correspondence.

[It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.—ED.]

To the Editor of the MARINE ENGINEER.

SIR,—In continuance of my remarks in the July number of your excellent Journal, on Simple and Compound Marine Engines, I wish to make a few practical remarks on the imperfect action of the single valve and link motion as applied to condensing engines when cutting off the steam at an early part of the stroke, by the valve opening the exhaust on the pressure side of the piston to the condenser before the completion of the stroke, causing considerable loss of power, as shown in No. 1 Table. I will now refer to the ordinary compound engine with cranks at right angles, as generally adopted, being the most suitable arrangement for working in back or fore gear. When the valves are worked together in unison from the same reversing shaft, there is a great loss of power in the large cylinder, by the advanced position of the piston, when the high pressure steam enters from the small cylinder, causing a great reduction in the effective pressure. Considerable loss likewise takes place by the premature exhaust to condenser. When using three cylinders, with the cranks at equal distance apart, the effective power of the steam is not increased, as the piston in the second cylinder has advanced a still greater distance when the strong steam from the high pressure cylinder is exhausted into it, and the premature exhausting of the steam to the condenser, causes further loss, the supply of steam of two different pressures, at two separate parts of the stroke, appears to me a misarrangement, neutralizing the power of part of the steam, by reducing the pressure in mixing with the low pressure steam that has entered the cylinder. In ocean steamers steaming to distant parts of the world, the loss arising from the causes enumerated form a large proportion of the cost of fuel, especially when coal has to be obtained at foreign stations.

Examples in the positions of the Pistons in Simple and Compound Engines with 24 *in. stroke, cranks* 90°.

SINGLE CYLINDER ENGINES.		COMPOUND ENGINES. TWO CYLINDERS.		
Steam cut off.	Exhaust open.	Small Cylinder. Steam cut off.	Large Cylinder. Advance of piston.	Large Cylinder. Exhaust open.
Inches.	Inches.	Inches.	Inches.	Inches.
20	22½	20	7	22½
16	21	16	4	21
12	20	12	3	20
8	18	8	1	18
6	16	6	½	16
4	13			

COMPOUND ENGINES.—THREE CYLINDERS.				
Small Cylinder. Steam cut off.	No. 2 Cylinder. Advance of Piston.	No. 2 Cylinder. Exhaust open.	No. 3 Cylinder. Advance of Piston.	No. 3 Cylinder. Exhaust open.
Inches.	Inches.	Inches.	Inches.	Inches.
20	12	22½	1½	22½
16	9⅛	21	⅛	21
12	8	20	¼	20
8	6	18	...	18
6	4	16	...	16

Comparative examples of the power of Turnbull Improved Compound Marine Engine and the ordinary compound engines, cranks at right angles, with equal capacity of cylinders and using the same amount of steam. Diameter of small cylinders, 24 in., stroke 24, area, 450 sq. in. Large ditto, 41½ in., stroke area, 1356 sq. in., stroke 24 in., steam cut off in small cylinder, 12 in., clearance and port, 1 in., total steam used 13 in., steam chest passages and clearance in large cylinder 5 in., total allowance, 6 in. of small cylinder's length. Steam cut off in small cylinder of Improved Engine, 10 in., clearance and steam chest, 3 in., total 13 in., initial pressure of steam used in cylinders, 75 lb., including atmosphere, 90 lb. absolute pressure; back pressure allowed for vapour in condenser, 2 lb. per sq. in. Exhaust port opens in small cylinder of ordinary engine at 20 in., when the piston has advanced in large cylinder 3 in., steam transmitted from the pressure side of small piston at half-stroke in Turnbull Improved Engine and piston at commencement of stroke in large cylinder.

Ordinary compound engine, small cylinder: mean pressure 71·7 lb. — 15·6 lb. back pressure = 56·1 lb. mean effective pressure × 450 in. = 25,245 lb. and in. Large cylinder: mean pressure 17·2 lb. — 2 vapour = 15·2 mean effective pressure × 1,356 = 20,611 lb. and in.

Improved Compound Engine, small cylinder: 64 lb. mean pressure — 2 lb. vapour = 62 mean effective pressure × 450 = 27,900 lb. and in. Large cylinder: mean pressure 20·4 lb. — 2 vapour = 18·4 lb. mean effective pressure × 1,356 = 24,950 lb. and in.

Small cylinder ... 25,245	27,900 small cylinder
Large ditto ... 20,611	24,950 large ditto
Total ordinary engine 45,856	52,850 total Turnbull's
	45,856

$\frac{6{,}994}{45{,}856}$ = 15 per cent. additional power over ordinary compound engine.

15 per cent additional power is rather more than 20 per cent. saving of steam.

WILLIAM TURNBULL.

14, Pellant Road, Fulham,
July 20th, 1880.

THE BOILERS OF THE LIVADIA.—Those engineers who hold that steel is not a good material of which to make boilers, will find support for their opinions in the failure of the boilers of the Czar's yacht, *Livadia*. This vessel was to have had eight main boilers of steel. Six of these were finished and ready for the hydraulic test of 150 lb. per square inch. On the pump being set to work the first boiler split through the solid steel plate, the longitudinal crack being about 3 ft. long, the pressure reached being 140 lb. The whole of the boilers were, we understand, thereupon condemned. It was determined, however, to proceed with the test, and three more boilers were easily burst with pressures varying, we are told, between 80 lb. and 140 lb. The plates were of Cammel's steel. This experiment will go far to cause the total rejection of steel by shipowners as a material for boilers. It is also stated that experiences recently acquired are all against steel as regards the durability of furnace plates; and some eminent marine engine builders will not employ it on any terms. So far, nothing more is known concerning the breakdown of the *Livadia's* boilers than the broad facts as stated above, but the subject is so important that it is to be hoped Messrs. John Elder & Company will supply full information on the subject.—*Engineer.*

THE NEW DOCKS AT HARTLEPOOL.—On July 6th the fine range of deep water docks, extending between Hartlepool Old Harbour and West Hartlepool Docks, was unexpectedly and without public ceremony opened to commercial use by the admission of the Norwegian barque *Sognadahm*, timber laden, from Pensacola, a vessel of 625 tons register, drawing 19 ft. 4 in. water. The main entrance used on July 6th is at the end of Hartlepool Old Harbour, where the approach is excellent in almost any weather, having 11 ft. on the bar at low water spring tides, when there will be 27 ft. on the new dock sills. From this entrance the large deep water dock, which has an area of 18 acres with 27½ ft. of water, is gained by passing through a long tidal basin or canal of equal depth, and spanning this at three separate points are fine iron road and railway bridges, the heaviest being 600 tons in weight. These, like the enormous gates placed at necessary intervals, are easily and expeditiously moved by centrally placed hydraulic machinery. The total dock and paved area is now raised to 170 acres, or, with timber yards, 350 acres. New warehouses, 300 ft. long, and sheds are being erected.

Notes and Novelties.

ARCTIC EXPEDITIONS.—This summer the steamer *Nordenskjold*, equipped by Mr. Sibiriakoff in Yokohama, will proceed from Japan along the northern shores of Siberia to endeavour to make the passage westward to the Atlantic. Several Scandinavian shipowners intend to send ships this summer to the Obi, Yenisei, or other Siberian rivers for commercial purposes, a scheme on which Professor Nordenskjold pronounces favourably. Mr. Leigh Smith, in his yacht *Diana*, is making a voyage to Spitzbergen. Mr. Gordon Bennett's steamer the *Jeannette*, which entered the American Arctic regions, *via* Behring Strait, has had to winter there, and a United States Government vessel has gone to her aid. There is also an American overland expedition to King William's Island, *via* Repulse Bay, seeking remains of Franklin's expedition. The United States steamer *Gulnare* has sailed for Smith's Sound to form a temporary station in latitude 82 deg. for observation and discovery. The station will be maintained for a few years, and will be annually visited by a United States vessel, and the men changed when necessary. Germany, Austria, Russia, Sweden and Norway, Denmark, Holland, and probably Canada, have arranged to establish observing stations at certain positions around the Arctic area. The places selected are the mouth of the Lena, the new Siberian Islands, Nova Zembla, Spitzbergen, Upernavik, Alaska, and the north of Norway. Germany proposes an antarctic expedition to winter in South Georgia, and Italy intends sending an exploring expedition to the antarctic regions. Lastly, a new British Arctic expedition is being organized at Ludgate Circus, with the object of going direct to the North Pole by balloons when navigation is not further possible on the ice. People persist in believing that balloons must necessarily be at the mercy of the winds, and are at a loss to know when and where the winds will be found to take a balloon to the pole and back.—*Engineering*.

A TRIAL has lately been made on the measured mile in Stokes Bay, under the superintendence of the steam Reserve and in the presence of the Controller of the Navy, of a service steam pinnace propelled by the *Mallory* screw. This is the first application of the American invention in the English service, and much interest was manifested as to the results of the trial. The propeller, which was fitted to a pinnace constructed specially for the purpose by Mr. J. Samuel White, of East Cowes, is capable of being turned to any angle by means of a pinion and gearing, like an ordinary rudder, with which it dispenses. The boiler is stowed away under the forecastle, while the cylinders are placed at the stern, and act directly upon the vertical shaft which turns the screw. Six runs were made with the engines going ahead and two with the engines going astern, there being scarcely half a knot's difference in the mean speed realized, 8·828 knots being obtained while going ahead with 339 revolutions, and 8·451 knots going astern with 340 revolutions. The engines were reversed from full speed ahead to full speed astern in ten seconds. But the most remarkable results were attained in turning, the little craft showing such remarkable handiness that it not only turned in its own length, 42 ft., but was put by Col. Mallory through the movements of a quadrille, chaining, setting to partners, and galloping to places. She made a circle to starboard in 36 seconds, and without stopping made a second circle to port, thus completing the figure 8 in 37 seconds. The trial was deemed satisfactory, but the vibration at the stern was so great that the after part of the boats fitted with the *Mallory* propeller will require to be specially strengthened.

THE AMERICAN.—In regard to the cause of the steamer foundering, it is supposed that the shaft in breaking rent asunder the stern tube, carrying away the after-part of the watertight tunnel with it, which would allow a greater quantity of water to enter the after-hold of the ship than could be kept under by the auxiliary pumps. Although the loss of property is great by the destruction of this fine ship and her valuable cargo, it is an illustration of the admirable equipment and discipline of an English mail steamer that all the passengers numbering 58, and the large crew of 76—or a total of 134 persons—were safely taken off the sinking steamer in her own boats, which were evidently in full readiness for such an emergency. The loss of the *American* is the most serious disaster which has occurred to the Union Steamship Company's fleet since the *European*, on her way from South Africa to this country, sank near Ushant on the 5th of December, 1877. On that occasion no lives were lost; all the passengers and crew were saved by the ship's boats. The Union Steamship Company carry the mails between England and the Cape in conjunction with the Castle Packets Company. The *American* was an iron vessel, but had five bulkheads, which should have divided her into seven watertight compartments. She was built in 1873, her gross tonnage being 2,126 and net tonnage 1,357. She was 320 ft. long and 34 ft. beam, her depth being 19 ft. 7 in., or 25 ft. 1 in., reckoned from the main of her two decks proper or the spar deck. She was built by Messrs. Stephen & Co., of Dundee, seven years ago, at which time Messrs. Gourlay, Brothers & Co., of the same port, put in her two compound engines, inverted direct action of 320-horse power, the diameter of the cylinders and the length of stroke respectively being 45 and 78-48 inches. The machinery was certified, the anchors and chains proved at a public machine, and the ship of the highest class, although not so large or swift as the latest built boats of the great limited company to which she belonged. She was registered at Southampton, from which port these steamers sail, calling at Plymouth, while the alternative steamers belonging to the Castle Packets Company (better known by the name of Donald, Currie & Co., by whom the line was established) sail from London, calling at Dartmouth. The *American* was built under special survey; her official number was 68,822.

SOCIETY OF ENGINEERS.—At a meeting of the Society of Engineers, held on Monday evening, June 7th, in the Society's Hall, Victoria-street, Westminster, Mr. Joseph Bernays, President, in the chair, a paper was read by Mr. Arthur Rigg, Engineer, of 1, Fenchurch-street, London, E.C., on "Sensitiveness and Isochronism in Governors." As the attainment of a regular rate of speed is the only object of a governor, it is an interesting inquiry how far this result is achieved by the sensitive and isochronous governors now frequently applied to steam engines. The irregular manner in which power is communicated from a piston to a crank causes periodical variations in speed, which vary greatly in their degree between such classes of steam engine as the common agricultural type and the high class mill engine. Whenever there is great sensitiveness in a governor, it is often found that inherent irregularities in speed tell to such an extent that the governor becomes uncertain, runs from one extreme of its range to another, and produces hopeless confusion in the speed of the engine it was intended to regulate—giving, in fact, a worse result than would be produced by a governor of the common type. This evil has been remedied by retarding the movement of sensitive governors, causing their movement to force fluids through small orifices, an unreliable method now superseded by a method invented by the author, whereby the balls overcome the inertia of a mass of metal as they move in or out, a plan applicable to the usual type of governors, and also to those which are direct acting, fixed upon an engine shaft, and altering the stroke of an expansion eccentric. Thus, such governors may be made to effect a more uniform regulation than has hitherto been attainable, and their extreme simplicity remains without attendant disadvantages. An illustration of the Relay system was given, where the governor moves a valve admitting hydraulic pressure under a plunger to raise or lower the sluice of a turbine, and so regulate its rate of motion. It was finally shown that governor and engine should correspond in their relations, so as to work harmoniously together; and that perfect regularity is unattainable, and can only be approached by providing sufficient inertia in the moving parts to diminish the effect of irregularities in power or resistance until the governor can operate; and that at a high rate of revolution attains this condition with the greatest economy and success, and that although the governor may advantageously approach isochronism, its sensitiveness must not be excessive.

THE Peninsular and Steam Navigation Company have entrusted to the Barrow Shipbuilding Company an order for the construction of two high-class steel steamers of about 4,000 tons.

THE boiler of the donkey-engine on board the English steamer *St. Oswin* exploded at Gibraltar on the 20th, killing two of her crew on the spot, and inflicting severe injuries on fourteen labourers at work on the vessel. The ship's cook has since died, and two more of the crew are lying in hospital in a most precarious condition.

NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 22nd June to 22nd July, 1880.

2522 H. Smith. Building iron and steel ships, &c.; hydraulic rivetting machines, &c.
2537 J. G. Hartley. Construction of ships' decks.
2553 H. P. Boyd, T. T. Pearson, and W. Hooley. Propulsion of steam vessels and apparatus therefor.
2590 G. and J. Weir. Preventing or diminishing corrosion in steam boilers.
2611 B. J. B. Mills (communicated by J. C. Thompson). Retaining berths, &c., on board ship level.
2641 H. F. Brion. Raising sunken vessels, transporting heavy weights, and loading, &c.
2649 J. Wetter (communicated by B. King). A combined seat and life saving apparatus for use on board ship.
2670 G. C. Palford. Construction of bottles for carrying messages at sea.
2693 J. D. Churchill. Safety valve apparatus for steam boilers.
2704 W. S. Brice. Apparatus for "trimming" grain or bulk cargoes.
2712 H. Hornby. Repairing after part of screw and other vessels without the use of dry docks.
2713 D. W. Sargent. Raising sunken vessels.
2724 G. Wilson. Securing armour upon ships, turrets, &c.
2758 H. S. Mackenzie. Winding machinery applicable to capstans and anchor lifters.
2766 T. Glover, jun. Steering apparatus.
2772 W. Lowrie. Preventing shifting of grain in bulk and coal cargoes.
2811 A. A. Rickaby. Ships' mast cap.
2814 Comte C. de Bove, Duc de Busègnans. Screw helm for steamers.
2847 S. Perkins. Steam boilers.
2894 W. Henman. Hopper barges.
2896 C. R. Simey. Steam steering gear.
2916 J. Coutts and H. Adamson. Governors for marine engines.
2917 F. W. Durham. Governors and speed indicators.
2923 Lieut.-Col. W. Hope, V.C., and R. S. Ripley. Ordnance, fire-arms and ammunition.
2949 A. Steenberg (communicated by M. A. Thunsden). Ships' windlasses.
2952 N. T. D. Barbier. Automatic luminous buoys.
2956 H. H. Lake (communicated by E. G. Parkhurst). Preventing excessive heating of barrels of machine guns.
2958 J. R. Neill. Ships' log.
2977 J. F. J. Dahse. Self-acting detachment for life buoys.
2983 H. E. Newton (communicated by N. Barney). Dumping boats.
2995 D. J. Morgan. Expanding and stopping boiler tubes, &c., whilst under pressure.
2997 H. C. Bagot. Navigable vessel.
3013 G. B. Thornton. Aquatic life saving and sporting dress.

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Hicks, Thos. H.	2 C	Shmptn.
Swaffield, N. A.	2 C	do.
Curr, Alex. G. ...	2 C	Dundee.
Bowran, Joseph	2 C	NShlds.
Atkinson, Fdk. C.	2 C	do.
Klintwort, Jno.H.	2 C	do.
Snowdon, John	2 C	do.
Finlay, William	1 C	do.
Norman, William	1 C	do.
Dunn, James D.	1 C	do.
Gair, John A. ...	1 C	do.
O'Flynn, John L.	1 C	do.
Taylor, George E.	2 C	Plymth.
Christie, John ...	1 C	Aberdn.
Martin, Peter ...	1 C	do.
Hamilton, T. M.	2 C	Belfast.
Harland, S. ...	1 C	N Shlds.
Neels, John E. ...	1 C	Bristol.
Brittain, Edward	1 C	do.
Paddon, George	2 C	do.
Thomson, J. M.	2 C	London.
Berry, Edwin ...	2 C	do.
M'Ewan, H. D.	2 C	do.
Christie, James	2 C	do.
Burghardt, John	1 C	do.
Birrell, Robert	2 C	Lvrpool.
Paterson, John ...	1 C	do.
Pattison, John ...	1 C	do.
Kelly, Robert ...	2 C	Glasgw.
Fettes, James ...	2 C	do.
Hamilton, J. A.	2 C	do.
Macfarlane, A. F.	2 C	do.
Crumbie, Edward	2 C	N Shlds.
Jones, Richard	2 C	do.
Gamblin, Geo. E.	2 C	do.
Brockett, Charles	2 C	do.
Rees, William ...	2 C	London.
Crammond, A. ...	2 C	do.
Stuart, P. O. ...	2 C	do.
Jones, Richard ...	2 C	do.
Hallowell, George	1 C	do.
Fraser, James ...	2 C	Hull.
Lawson, J. W. ...	2 C	N Shlds.
Lovell, Robert ...	2 C	do.
Dunn, Thos. S.	2 C	do.
Stobbart, Eman.	2 C	do.
Hagill, Robert ...	1 C	do.
Patterson, Wm.	1 C	do.
Shields, George	2 C	London.
Baxter, John ...	1 C	do.
Paton, Thos. G.	1 C	London.
Tyrrell, William	2 C	Lvrpool.
Marr, William ...	1 C	NShlds.
Mabbs, John W.	2 C	London.
Morrison, Peter A.	2 C	do.
Steward, Saml. C.	2 C	do.
Vigeon, Henry ...	1 C	do.
Stirling, James ...	1 C	do.
Lees, Charles ...	2 C	Lvrpool.
Goss, William ...	2 C	do.
Roberts, Eli ...	2 C	do.
Hunter, Thomas	1 C	do.
Greaves, Robert	1 C	do.
M'Gregor, Ben. ...	2 C	Glasgow.
Lyons, George ...	2 C	do.
Bolton, Hugh ...	2 C	do.
Gray, Archibald	2 C	do.
Greenhorne, A. ...	2 C	do.
Catherwood, S. ...	2 C	do.
Morrison, D. ...	2 C	do.
M'Eachern, John	2 C	do.
Falconer, John ...	1 C	do.
Harrower, John ...	1 C	do.
Nimmo, William	1 C	do.
King, Robert ...	1 C	do.
Oliver, John ...	1 C	Sndrlnd.
Morton, John H.	1 C	do.
Pantry, Gilbert ...	1 C	do.
Pelton, Arthur ...	1 C	do.
Swaine, Richard	2 C	Glsgow.
Ross, William ...	2 C	do.
Brown, Alex. ...	2 C	Lvrpl.
Denton, George M.	2 C	do.
M'Farlane, Thos.	2 C	do.
Barr, Hugh A. ...	2 C	do.
Edmunds, Thos.	2 C	do.
Laing, Thomas A.	1 C	do.
Cranston, D. G.W.	1 C	do.
Good, Henry ...	2 C	Hull.
Press, Arthur J.	1 C	do.
Rankin, G. J. ...	2 C	Lvrpl.
Shepperd, Henry	2 C	do.
Mercer, John ...	2 C	do.
Brimer, William	2 C	do.
Johnston, John ...	1 C	do.
Parry, Thomas ...	1 C	do.
Clark, Donald ...	2 C	Grnock.
Andrew, James ...	2 C	do.
Cameron, Donald	2 C	do.
Salkeld, Joseph	2 C	N Shlds.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen
32, Basinghall Street.

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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

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NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

The Marine Engineer,

LONDON, SEPTEMBER 1, 1880.

EDITORIAL NOTES.

THE stowage of grain-laden ships is now a subject of earnest discussion and investigation. It is probable that either the penalties of the Act of 1876 will be more stringently enforced or that new legislation will still further fence round the stowage of grain with restrictions and inspections. As the penalty enforced by the Act of 1876 amounts to £300 against owners and masters for knowingly allowing ships to go to sea with grain cargoes improperly stowed, this would seem to us to be an ample guarantee against wilful negligence. The difficulty more probably is to know when grain cargoes are properly stowed so as to be secure against shifting in a heavy sea. That there are very many cases which require supervision, and in some cases penalties enforcing, is obvious from the appended list of grain-cargo vessels, which have met with casualties in consequence of the cargo shifting or have been reported as insufficiently secured. We think the best protection against the recurrence of so many casualties from shifting grain cargoes is a more extended recognition by ship owners of the most secure conditions of grain cargo stowing. We have done what we could to draw attention to many improved suggestions for grain cargo stowing, and we should be glad to receive any correspondence which may further serve to demonstrate the best conditions of safety in stowing grain cargoes in ordinary holds.

ANALYSIS OF RETURN.

	1875*	1876	1877	1878	1879	1880†	Total,
1. Number of cases in each successive year	11	46	15	17	12	8	109
2. Number of cases in which there has been a casualty or a shifting, or a list or bad stowage, and in which there has also been a preliminary survey abroad ...	6	20	6	8	3	5	48
3. Number of cases of shifting or list, in which the reports of the Board of Trade Surveyors show the stowage to have been in fault	8	14	4	7	4	Nil	37

FURTHER ANALYSIS.

4. Cases in which upon receipt of Surveyors' reports Board of Trade did not interfere	68
5. Cases in which owners or masters were cautioned ...	32
6. Case of prosecution	1
7. Cases in which Board of Trade, though disposed to interfere, could not do so on account of survey abroad	4
8. Cases in which ship was discharged before survey could be completed	3
9. Case in which cargo was re-stowed for exportation ...	1
Total ...	109

* Oct. to Dec. † Jan. to June.

We all know the theory firmly held by theologists that all nations have their climax of power, and then gradually wane and disappear from their supremacy to allow younger nations to forge to the front. We all at least hope that this course of events will not take place for Old England in our generation, if ever. But we are becoming sadly remiss, at least in maintaining, what has long been our birth-right—the naval supremacy of the seas. It is to the condition of our large ordnance that we refer. It our last issue we referred to the unaccountable supineness of the Government in neglecting to avail themselves of excellent offers from outside inventors to manufacture for their approval ordnance that should, at a fraction of the present cost of Woolwich guns, beat them out of the field for efficiency. We must note also that Colonel Stanley, no longer ago than the 1st of March, reported to the House that the Woolwich gun was become a practical failure. Of course he could not admit this in so many words, but when the departmental mouthpiece says that it was not necessary to "condemn at once all the Woolwich guns," it must be taken as practically a statement that they are valueless. This being so, why does the useless expenditure of public money go on in the continued manufacture of six 80-ton guns, twenty 38-ton guns, twelve 25-ton guns, twenty-four 18-ton guns, and three heavy breech-loading guns, as was stated by Mr. Childers the other day to be the case, in answer to Baron de Worms. It is pleasing to our national dignity to know that the Italian Government possesses heavy iron-clads, armed with 100-ton guns of their own manufacture, with which they could, at a distance, soon dismantle our heaviest vessels and forts, whilst the shot from our largest 80-ton guns would only rattle off her armour like small shot off a crocodile. It is to to hoped that England will soon arouse herself as to the blindness or stupidity of the departmental officers and if they will not see what others can plainly see, the country would get on as well, and a deal more cheaply without them.

Some little excitement has lately been caused by the successful voyage of a small vessel across the Atlantic, with engine and boilers of the Perkins type, and which has accomplished the journey with the small consumption of 1 lb. of fuel per indicated horse power per hour. Although this is a great advance in economy over that attained by most marine steamers, it is yet nothing like the economy that we may hereafter hope to effect, with improved appliances and more scientific modes of dealing with the combustion of fuel. We state this opinion from the following known facts as to the evaporative efficiency of fuel. One pound of fuel is able to develope, when completely and scientifically consumed, 14,500 British units of heat, which are understood to mean by a unit that quantity of heat which is capable of raising one pound of water through one degree Fahrenheit. These 14,500 units of heat will then, in such case, be sufficient to evaporate 15 lbs. of water, taking the latent heat of evaporation to be 966·6° F. But we know that as a rules only 10 lbs. of water at most can be evaporated in an ordinary boiler, so we have, therefore, a loss of 33 per cent. at once of the heat which never enters the boiler at all but goes up the chimney. Nor does the water so evaporated give off anything like the work equivalent to the heat absorbed in evaporation. For it is well known that each British unit of heat is equivalent to 772 ft. lbs. Therefore each pound of fuel is equivalent to $14,500 \times 772 = 11,194,000$ ft. lbs. Now, in the instance we have mentioned, where the combustion of coal per hour was only 1 lb. per horse power, 60 horse-power will have been developed during that hour, so the 1 lb. of fuel will have developed a total power of $33,000 \times 60 = 1,980,000$, or nearly 2,000,000 ft. lbs. But this is still not $\frac{1}{5}$ of the theoretical value of the heat of the fuel, so that although this result is excellent in degree and compared with former extravagant results, we must not forget that the ultimate economical limit is not reached until we have reduced the consumption to $\frac{1}{5}$ of a lb. per indicated horse-power per hour. It is evident that to accomplish this no heat must be allowed to escape up the chimney, and the whole heat absorbed by the steam or other elastic power agency, must be converted into work, which we are not at present able to do, but it is well to keep such a goal before us.

As a striking instance of the utter want of sound commercial management displayed by Government departments, we need only refer to the official information just given to the House as to the cost of naval repairs. We find the ***Hotspur***, only ten years old, and having only been in commission for an aggregate period of two years and nine months, already debited with £102,000 for repairs, when her first cost was only £175,000. If this vessel had passed through a series of destructive engagements her repair bill could hardly have been higher. The ***Briton***, launched in 1869 at a cost of £66,000, and only in commission for four years and a half, has cost the country £44,000 for repairs, just two-thirds of her cost price. In the cases of the ***Thistle*** and ***Cracker***, their repairs have already equalled in cost their original value. These are, however, comparatively old ships, having been launched in 1867 and 1868. What, however, can be said for the ***Mallard***, which, constructed only five years ago, has had to be repaired at a cost of £9,498, nearly equal to half the sum that covered her building and equipment. To cap the whole climax, the ***Juno***, launched in 1867, and only in commission nine years, cost originally £78,249, and has since had £81,063 laid out upon her in repairs. We rather think that if such figures were submitted by any of our limited great steam ship lines, there would be a prompt vote of want of confidence in the management. What a pity there is not a National Navy Co., Limited, with management and officers elected by the shareholders, the profits resulting from sums paid Government when ships were required in commission. We might expect then a little better commercial economy in the maintenance and fitting of our navy.

THE last sham fight at Portsmouth has again been a subject of much attention and interest, as the most practical test that can be afforded as to our means of attack and defence against the new and modern engineering appliances. A great improvement in the form of opposing booms was introduced on this occasion. Instead of being merely one or more heavy spars or balks of timber lashed together across the stream, it was, on this occasion, formed by a series of balks of timber placed endways to the stream and the attack. These balks are connected together by two heavy chains some distance behind each other, thus forming a formidable grate or network with impenetrable heavy rams of timber, which no ironclad would dare to charge. If even several portions of the balks and front chains were broken, the boom would still offer a perfectly substantial resistance until both chains were shattered. If the chains were multiplied, this would seem to be a form of boom capable of an infinitely protracted defence. In this case, however, the attack was able successfully to explode charges both on the balks and chains, and thus to force their way in through the boom, opening a passage for the following "creepers" and gun-boats. We think this successful attack was entirely due to the extremely bad handling of the field-guns, which were one of the principal flank defences of the boom, as we cannot imagine a successful attack of open boats upon such a boom under a well-sustained artillery and small-arm flanking fire, no boat could live under such circumstances. In the after operations of clearing a passage through sunken mines for the following gun-boats and ironclads, much uncertainty exists as to how far this was effectually accomplished, as the passage cleared was not very wide, and a large number were found still uncut on after examination. An interesting fact was elucidated in the following night operations, viz., that fog and smoke effectually bar the illuminating action of the electric light, and but serves to make the defenders more visible.

THE *Allgemeine Zeitung* states that several steamers have been lately built at Rostock for a Russian commercial firm, designed specially for service on the Caspian Sea. They will be worked with two screws, and the heating apparatus has been so designed as to allow the use of Russian petroleum. With machinery and cargo these vessels will draw only 4½ ft. of water. Their first employment is said to be the transport of great quantities of rails for railroads to be made through Russian Turkestan.

WEST HARTLEPOOL AND ITS NEW DOCKS.

WEST HARTLEPOOL is one of those mushroom towns of which its neighbour Middlesborough is a striking example. Founded in 1847, by Ralph Ward Jackson, on a strip of land to the south of Old Hartlepool, it was meant chiefly for a coal shipping port. For some years the coals from the Clarence Railway had been sent via the Stockton and Hartlepool line to be shipped at Old Hartlepool. But the traffic was not so great as either of the companies had expected it would have been, and when the three years' arrangement which had been made between the Railway Company and the Dock Company, was completed, the latter company declined to renew it. In consequence of this the new port of West Hartlepool was founded to give an outlet to a great quantity of the coals which had hitherto been shipped at Old Hartlepool.

The first dock was opened in 1847, and so quickly did trade with the newly formed town spring up, that it was soon found necessary to construct two more docks These docks, although fully equal to the requirements of the old-world colliers, were quite unsuited to the large steamers which have come so much in vogue of late years. Besides this, the trade of the port was being rapidly extended. Not only was a large coal trade done, but the import trade was also assuming formidable dimensions. During the very brisk times of 1872 so evident was the necessity for increased accommodation at West Hartlepool, that the North Eastern Railway Co. —to whom the docks now belong—decided to enlarge the docks. It was originally proposed to simply enlarge the old docks by taking in part of the Slake—a long strip of morass, lying between the two Hartlepools, and covered by the sea at high tide—but this intention was altered when the Port and Harbour Commissioners informed the railway company that they would undertake to maintain a minimum depth of 11½ ft. on the bar at Old Hartlepool.

It was therefore decided to utilize the whole of the Slake for the proposed extension, and have two entrances to the new docks, one into the old west docks, and the other, a deep water entrance, at the Old Hartlepool side. These works are now completed, and the result is the increase of the dock accommodation at West Hartlepool, to a total of about 176½ acres, of which 120 acres are in direct communication. It was necessary, before the new docks could be completed, to change the route of a railway connecting the two Hartlepools, and which crossed the Slake. At a cost of £98,000 the alteration was effected, and in the course of it, 200,000 cubic yards of earth excavated from the new docks have been used in constructing the embankmen of the new railway.

If we commence our tour of inspection of the new docks at the Old Hartlepool, or deep water entrance, we come first to the large tidal lock, which is 550 ft. long, and possesses an area of 3 acres. It will at all times have a depth of water of 26 ft. Besides the huge sets of dock gates (which are constructed of iron, in water tight compartments) at each end, the lock is spanned by two massive iron bridges, which are decidedly the most striking features of the new works. They are each designed on the centre pivot system, and weigh 700 tons each. The swinging platform on each bridge is 500 tons in weight, 208 ft. in length, and 40 in breadth. They are divided down the middle by a huge iron network, which separates the railway from the foot and cart traffic. A noteworthy feature here is that the traffic will never be for a moment stopped. The bridges will, of course, never be open both at the same time, but when one, say that at the west end, is opened, a signal will be hoisted, showing that such is the case, and all traffic will then be directed to the other bridge, and *vice versa*. The railway lines and roads have been constructed to admit of this being done.

Leaving the lock we come to the large new dock, on one quay of which we find the foundations of the new warehouse, which will, when completed, be 300 ft. long, 100 ft. wide, and five storeys high. It is estimated that it will store about 50,000 quarters of wheat. At the north end of this dock is the site for two new graving docks, and on the west side we have the new timber pond providing increased accommodation for one of the chief trades of West Hartlepool, and which will add also to the quantity of water at command for working the lock system. In this dock a depth of 26 ft. will be maintained at ordinary high tides. Next we come to the first of the new docks, with an area of 15½ acres, and immediately connected with the old Jackson and Coal docks, and with an entrance from the sea by a tidal basin. Near this tidal basin we have the engine house, in which are two engines for working the pumping machinery and the hydraulic power, by means of which the dock gates and bridges will be worked. The hydraulic machinery has been constructed by Sir William Armstrong & Co., of the Elswick Works. Although only two pairs of engines are at present erected, space has been left for the erection of two more when necessary. New coal spouts are also being erected 10 ft. higher than the present ones, so that the largest steamers may load in the Jackson Dock, and proceed to sea by the deep water entrance.

A few figures will give some idea of the magnitude of the work performed here. Although the foundations have been dug out of hard clay, thereby saving an enormous amount of concreting, there has still been used 17,000 yards of concrete at the locks. There are more than 100,000 cubic yards of rubble work, 300,000 feet of ashlar work, and 20,000 ft. of granite set at the sills and quoins. The new quay walls are 6,000 ft. in length, and the area of wharfage 58 acres. The total cost of the extension will amount to £500,000.

The plans of the extension have been prepared by Mr. T. E. Harrison, the able chief engineer of the North Eastern Railway Co., the works carried out under the direction of Mr. C. Harrison, and Mr. Walter Scott, of Newcastle, was the contractor, his representative here being Mr. Thomas Middleton.

RANKIN & BLACKMORE'S COMPOUND TUG ENGINES.

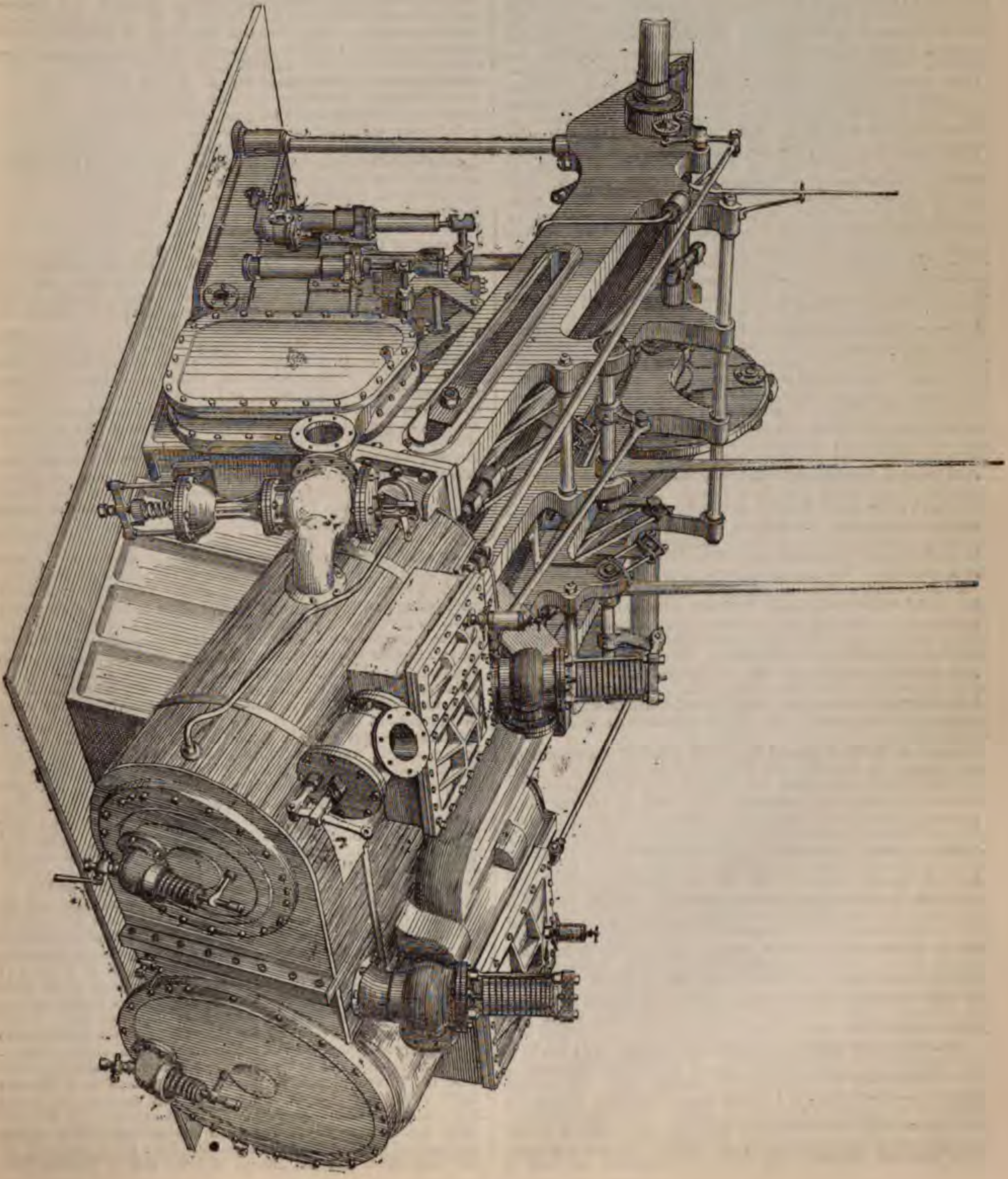
We herewith give an illustration of the engines of paddle tug *Mount Etna*, constructed by Messrs. Rankin & Blackmore, of the Eagle Foundry, Greenock, for the Queenstown Towing Company. These engines are of the two-cylinder disconnecting compound principle, patented some years ago by this firm, who have applied this arrangement to a number of twin screw and paddle steamers.

The engines illustrated are of the diagonal type, and have cylinders 25 in. and 48 in. diameter, the stroke of both being 5 ft. Two boilers 10 ft. 7 in. diameter and 9 ft. 4 in. long, with four furnaces 3 ft. 4 in. diameter, and a total heating surface of 1,900 square ft., supply them with steam at 70 lb. pressure. The high pressure cylinder is fitted with an expansion valve, adjustable to various degrees of cut-off. The special feature of these engines is the patented arrangement for working them independently of each other; when it is desired to do so, they are uncoupled in the ordinary manner, the high pressure engine when working alone exhausts through the receiver to the condenser a spring loaded escape valve, allowing any of the exhaust steam above 15 lbs. press to escape into the atmosphere; the low pressure engine when working alone is supplied with steam direct from the boilers, through a reducing valve loaded to 10 lbs., and becomes virtually a single low pressure engine.

This arrangement satisfactorily overcomes the difficulty of compounding paddle tug engines, and whilst retaining all the advantages (real and supposed) of compounding, they are as easily handled independently of each other as if they were two simple engines—a property of considerable importance to a tug when manœuvring in docks and narrow waters.

The *Mount Etna* was built by Mr. Robert Chambers, Jun., of Dumbarton, and made a most successful trial trip, giving a speed of 12½ miles an hour, the engines making 37 revolutions, and indicating 500-horse power.

RANKIN & BLACKMORE'S COMPOUND TUG ENGINES.



NAVAL DEMONSTRATION AT PORTSMOUTH.

THE famous night attack by the naval torpedo forces of Portsmouth, on the 16th of October last year, upon the defences of the Royal Engineers in front of Fort Monckton, will still be remembered as a demonstration at once novel and impressive. The practical exigencies of an actual attack and counter-attack were respected as far as it was considered practicable; and the battle was so hotly contested both ashore and afloat that each side claimed to have won a grand naval victory. The contest, however, left much to the imagination, and in the result relegated many important questions for further consideration and experiment. Owing to the serious illness of Dr. Domville, Inspector-General of Haslar Hospital (which ended fatally a few days subsequently), the defenders were precluded from using their field and heavy ordnance except in the merest supposition, while one of the most important objects of the battle—viz., the ascertainment of the effect of smoke from guns upon the electric light—could not be determined. It was consequently resolved to repeat the attack and defence under more realistic conditions, and the affair came off on August 10th, in the presence of the Prince and Princess of Wales, the Board of Admiralty, and a host of professional critics and spectators. The plan and arrangements were substantially the same as last year, with the essential difference, however, that the attack was carried out in broad daylight instead of under cover of the night. On the former occasion the advantages were clearly on the side of the enemy, and against Captain Ramsay and his submarine miners, who had to search out the creeping and countermining craft by means of a Siemens projector, and who were only able to bring their artillery and musketry to bear by means of the brief and transitory glimpses of the attacking forces thus obtained. As the conditions were now apparently reversed—the attack being exposed, while the defence was for the most part concealed—it might have been supposed that the conflict was certain to end in an easy victory for the land forces. This conclusion, however, was scarcely warranted in the circumstances, and was certainly not justified by the result. In the first place, the assault was more comprehensive in its character and more vigorously conducted, while the rebutting means at the command of the defenders were absolutely the same. An actual ironclad, the *Glatton*, which was assumed to represent the vanguard of an hostile fleet, was brought into requisition, and served as a cover and a base of operations for the torpedo attack upon the mined area. A fleet of gunboats also assisted in the attack, so that the gunners on shore, while endeavouring to destroy the small craft of the enemy, were themselves brought under the fire of the ships. The regulations, as regards hits, were also altered to the disadvantage of the engineers, the number requisite to put a boat out of action having been materially increased. The soldiers also laboured under the further disadvantage of having had their plan of defence discovered by an amateur Intelligence Department, the consequence being that the fleet of the enemy came upon the scene specially prepared for the obstructions which they had to assist in removing. It was also noticed that, owing to the proximity of the *Glatton*, there were no guard boats, which in other circumstances might have made it hot for the torpedo craft by means of machine guns.

According to the "general idea," the object of the operations was primarily to ascertain the best means of forcing a channel defended by submarine mines and obstructions, supplemented by the fire of artillery and infantry. This channel was the same important piece of water which had formed the scene of the two previous contests between the sea and land forces. It ran between the coast, extending from Gillkicker Fort, at the sea end of Haslar Wall, to Fort Blockhouse, at the harbour end, and an imaginary shore line opposite, and was defended by submarine mines, supplemented by obstructions, floating and fixed. While, therefore, the operations of the defence were limited to putting the attacking fleet (with the exception of the *Glatton*) out of action, the operations of the attack, on the other hand, were limited to breaking through booms and obstructions, countermining, removing and disabling mines, destroying cables, and putting guard boats and field guns *hors de combat*. The mine field was 700 yards in length, but narrower than on former occasions, being only about 500 instead of 800 yards wide. Between the channel and the forts was an apparently open space of water about 300 yards wide; but as it was supposed to be blocked by fixed and permanent obstructions, it was hermetically closed against all vessels. This was marked with buoys and red flags, and if any predatory craft was seen within the line it was at once ordered out of action. Spectators in boats were also warned off the debatable territory, and Admiral Ryder had taken the precaution to inform the public that any encroachment upon the defended area would be dangerous not only to boats, but to life. The attacking force consisted of Her Majesty's Ship *Glatton*, which represented the leading ironclad of a squadron, and carried two 25-ton guns and a brace of 20-pounder torpedo guns; four gunboats—the *Medway*, *Spey*, *Vesuvius*, and *Manly*—two of which carried their usual armament of three 64-pounders, the others being unarmed except for the purpose of destroying mines; 12 torpedo boats and steam launches, besides several rowing boats. At the time the friendly action began it was supposed that the hostile force had silenced the heavy guns in Fort Gillkicker and the advanced batteries on the imaginary shore, and that the *Glatton* had taken up a position at the head of a channel 120 yards wide, which had been cleared by the attack in previous countermining operations, and was in the act of despatching her attacking flotilla to remove the remaining obstructions, and force the passage to the town and dockyard. In this extremity the only heavy artillery which remained for the defence were the guns in Fort Monckton, consisting of four muzzle-loading rifled 64-pounders, two small-bore 8 in. guns, and one breech-loading rifled 7 in. gun; the other available means at the command of the patriotic party being the O field battery of the 3rd Brigade Royal Artillery (of which four 16-pounders were placed in position on the western side of the fort, and a couple on the eastern side), under the orders of Colonel Hope Johnstone, a company of Royal Engineer Submarine Miners, and a battalion of infantry represented by three companies from the 1st Battalion 24th Foot, under the command of Captain Tongue. The defending forces were under the command of Colonel Schaw, R.E., while the electric and mining operations for the protection of Fort Monckton and the channel were under the superintendence of Captain Ramsay, R.E., commanding the submarine miners. The attack was conducted by Captain Gordon and the officers of the *Vernon*.

The chief umpires, Colonel Graham, R.E., V.C., and Captain Bosanquet, R.N., took up their position with the defenders on the western bastion of Fort Monckton, while the assistant umpires, Commander Beaumont, R.N., and Lieutenant-Colonel Ritchie, R.A., were placed with the enemy on board the *Glatton*. Sub-umpires, in pairs, from the Navy and Army, were also stationed at each gun ashore and afloat, in the test room inside the fort, at the various firing positions, on board of each vessel engaged, and with the infantry of the flanks and curtain. To carry out these duties 11 officers on experience were drawn from the Royal Artillery, 10 from the Royal Marine Artillery, 15 from the Royal Engineers, two from the 2nd Battalion 12th Foot, two from the 69th Foot, and one from the 108th Foot, the same number of naval officers being taken from the harbour squadron. It was really upon the promptness and alacity of the sub-umpires that the practical value of the operations depended. They were prohibited from taking part in any way on the side of the attack or the defence, either by giving advice or expressing an opinion during the progress of the engagement. Their duty consisted in recording in tabular forms supplied for the purpose, the facts that came under their observation, and in ruling the several guns, boats, and men out of action as soon as they became disqualified. The disqualifications were very stringent, but pressed more than usually severely upon the gunners in the fort. On the previous occasion six imaginary hits sufficed to put a gunboat, and three a torpedo launch, out of action; and it was agreed that if a row-boat came within the electric ray for one moment, whereby it became exposed to a musketry fire from a distance not exceeding 300 yards, it was to be ruled out of the fight. On this occasion, on the other hand, eight hits from large guns, or 16 from field guns, were required to disable a gunboat or first-class torpedo-boat, six hits from any gun being held sufficient to put all other craft out of action. In like manner, four hits from an ironclad or a gun-boat were understood to practically destroy a field gun. Even supposing, therefore, that almost every shot proved a hit, the swift torpedo boats and pinnaces had an excellent chance of damaging the obstructions and connections before they could be ruled out of action. The effect of the infantry fire upon the attacking flotilla, always a difficult matter to determine in mimic warfare, and of the fire of the attack upon the infantry of the defence, was left to be determined by the umpires at the close of the operations. Explosions of blowing charges within 30 ft. of any vessel or boat were considered as disabling her. These charges, which were assumed for the purpose of the operations to represent ground and buoyant mines—mechanical, electro-contact, and observation—and to spread corresponding destruction around, were not to exceed 2 lb. of powder when placed 24 ft. or more under water; but if in shallower water they were not to exceed 4 oz., and in no case were they to lie on the surface. It was also ruled that in case a boat succeeded in attaching a charge to any obstruction, she might claim immunity from being disabled, on the supposition that the charge, if fitted with a Bickford fuze, would explode whether, after fixing it, the boat were captured or not. Having once, however, claimed immunity, she could take no further part in the attack, and she was moreover, prohibited from replacing the charge in the event of its missing fire. The whole business, indeed, will remind the reader of the war scenes in *Henry V.*, and there were many spectators of the same opinion as Fluellen, that it was not good to come to the mines, "For, look you, the mines is not according to the disciplines of the war." In order, however, to minimize the danger, it was agreed that, before firing a charge, an attacking boat should be required to hoist a red flag as a signal that all operations were to temporarily cease, and that all craft were to retire, for purposes of safety, to a distance of 300 yards until after the charge had exploded or a misfire had been proved. For it need scarcely be said that obstructions in the shape of booms and chains could not be broken through by make-believe detonations, but that it was necessary to remove them by practicable charges of powder and gun-cotton. When a countermining boat, again, was signalled out of action, she was ordered to ship all her mines and sheer out of danger from their explosion before anchoring, and the sub-empires on board were requested to carefully note whether any electro-contact mines were exploded by her when moving away. All vessels except "creeping" boats employed in the attack were distinguished by alphabetical flags; while the field guns were distinguished by numeral flags; and the sub-umpires were instructed that hits, to be effective, should be directed at the hull, and not at the flag, of the boat or vessel, and were to rule accordingly. Each hit was communicated at once to the chief umpires, who could alone rule boats out of action from the shore, and to the assistant umpires on the *Glatton*, who alone could declare guard boats and field guns to be disabled.

Time was advisedly an uncertain factor in the operations, for as the demonstration was supposed to be of a pre-eminently practical character, it was not to be supposed that the attacking side would commit the egregious folly of announcing beforehand the moment at which they proposed to make the onslaught on the works of the defence. The sub-umpires mustered soon after 8 in the morning for the purpose of regulating their watches by signal, and it was understood that the attack should not be made before 9 o'clock. It might, however, have been indefinately delayed; and as there was no knowing at what moment the quick and snake-like torpedo boats might rush from the effective cover of the ironclad, the gunners and electricians in the fort were kept on the alert. At 9 o'clock it was evident that Captain Gordon was preparing to attack. Clouds of smoke arose from the funnels of his fleet, and soon after feathers of steam were seen ascending from the waste pipes. At this moment the launches, torpedo-boats, and creeping craft were all huddled together behind the turret-ship, while the *Medway* and the *Spey* (easily distinguished by her broken topmasts) were seen through the haze to be slowly drifting to the westward. The *Vesuvius* was standing considerably out to sea in the background. Admiral Ryder, in the *Fire Queen*, had taken up a position outside the line of buoys, where he was presently joined by the Lords of the Admiralty, who had just arrived from Cherbourg in the *Enchantress*; by Mr. Brassey, the Civil Lord, who came upon the scene in the *Sunbeam*; and at the end of the action by the Prince and Princess of Wales in the *Osborne*. It was not, however, before twenty-three minutes past nine that the first gun fired from the fort announced that the attacking flotilla had emerged from the cover of the *Glatton* and were coming into action. As on the occasion of the night attack, the efforts of the enemy were mainly directed to encompass the destruction of the formidable boom, which not only blocked the passage of the whole channel to be cleared, but served to protect the electric connexions between the shore batteries and the nests of sunken mines. This obstruction formed the object of as obstinate a struggle between the rival combatants as the famous bridge in Shakespeare between the French and English. There were, indeed, some very excellent services rendered at the "boom," and none the less so because the obstacle proved a very different thing from the one used at the previous conflict. On that occasion the boom consisted of an arrangement of spars joined together in a way thought to be effective, and placed at right angles to the fort. As a matter of fact, however, the only difficulty experienced by the enemy was in approaching it, as it was commanded by the heavy ordnance and infantry from the shore. But the moment the blue-jackets succeeded in attaching to it a charge of gun-cotton, it was easily shivered, and the *Vesuvius* and *Bloodhound* steamed through the fissure. Now, on the contrary, the boom was constructed after the manner of a gridiron, a number of balks of timber being placed parallel to each other, and to the face of the fort, and with the ends consequently pointing in the direction of the attack. For the purpose of keeping the balks at a proper distance of 6 ft. apart and securing them, and at the same time opposing obstructions to the passage of small craft through the interstices, three rows of chains were placed across them at regular intervals, thus forming the meshes of a rigid net, the whole being kept in position by mooring anchors placed fore and aft. It will thus be seen that the fracture of a chain, or even the destruction of one or more of the balks, would not open a passage for ironclads, but that the reticulations would have to be fatally injured in many places before the boom would cease to be operative. And when it is stated that the obstruction was so placed as to be under a concentrated fire from the defenders' guns, the hazardous nature of the enterprise will be self-evident. Both in front and in rear of the boom the passage was further impeded by nets floated by means of cork, the object being to foul the screws of the steam craft, while in the rear of all a suostantial spar was placed across the channel, the whole area being at the same time covered with sunken mines. The character of the defence was well-preserved, but still not so completely as to prevent the other side from gaining a wrinkle. Both the timber and the chains were obtained by requisition from the dockyard, and with so many balks for the first part of the puzzle and so many shackles of chain cable for the second, it was no difficult matter for the navy to arrive at a pretty accurate idea of the obstacles to be surmounted. At all events, the *Manly* and the whole of the topedo boats, launches, and pinnaces had their cutwaters specially protected, and as the protection took the shape of a spar descending obliquely to below the keel, it was admirably adapted for enabling the vessels to run over chains and floating *débris*. Simultaneously with the despatch of the creeping craft, the *Glatton* engaged the guns of the fort, and thus served to distract the attention of the defenders from the proceedings of the small fry. But nothing can excuse the wretched service of the four field guns on the right of the fort. These guns were placed in masked embrasures, concealed from the enemy by furze, and had they been well served it would have been impossible for the creeping craft to have reached the boom without being disabled. As it was, however, of the three first which attempted to force the passage, not one was apparently affected by the artillery fire. The first launch seemed actually to leap over the obstruction and to carry its attendant dingey with it. The second was hung up high and dry in the chains, where it was subsequently succeeded by another creeper, the crews of which had to be taken out of danger by row-boats. The third boat succeeded in actually passing through the boom, but came to grief and sunk through the explosion of one of her own creeping charges. While this was going on the *Glatton* kept up a withering fire upon the fort, the whole ship being obscured in a cloud of smoke, during which it would have been comparatively easy for a guard boat to have assailed her in a vulnerable part. How the sub-umpires were enabled to fulfil their duties in the circumstances we know not, but when the gentle westerly breeze lifted the fog, a couple or so of row-boats had succeeded in attaching a charge of gun-cotton to the boom. The buglers blew a "Cease fire," and after the crews had betaken themselves to a place of safety, a majestic explosion occurred, which seemed to shatter the boom for a considerable distance of its length. This, however, was not the case, for while the balks were destroyed, the chains remained intact, and the passage continued to be disputed. And now occurred the most interesting and exciting part of the combat. The *Vesuvius* and *Medway*, with "cow-catchers" lowered, came into action under a tremendous fire from the defenders, with the evident intention of forcing a passage, the *Medway* at the same time engaging the fort with her 64-pounders. Both gunboats ran full tilt against the chains, dragging what appeared to be countermining barges after them. As no men, however, were seen on board depositing the countermines, the defenders saw through the ruse. The barges were, in fact, dummies, and the shore artillery concentrated their fire upon the gunboats. But, notwithstanding the admirable target which they presented at short range, they were allowed by the umpires to proceed, and they succeeded in breaking through the chains without being entangled in the nettings. They were afterwards followed by the *Manly* and *Spey*, the latter fighting her guns as she came along. Both passed through the obstruction in safety and without being under the necessity of striking their colours. This practically ended the engagement. Of the torpedo boats and launches belonging to the attacking party, no fewer than 11 were declared out of action by the umpires, one being destroyed by her own creeping charges, and another by a line of mines exploded from the miner. But the boom had been forced, and this was the object of the attack. It remains to be seen, however, whether a space was cleared sufficiently large for the passage of the *Glatton*. It is supposed that only about 500 yards had been cleared out of the 700 yards of channel, and that there were many mines still operative at the conclusion of the attack was apparent by the electrical explosion from the fort, after Captain Gordon had hoisted the "recall," at half-past 10. Indeed, as there were as many dummy connections as real connections in the disputed channel there is reason to think that the creeping craft exhausted a great part of their zeal in destroying cables which had been sunk for the express purpose of being destroyed, and thus of misleading them. This can only be determined by subsequent examination. Each line of countermines is supposed to be effective for 60 ft., and hence a double line should clear a passage 120 ft. broad. But in order to do this it is essential that they should be deposited in the midst of the defenders' submarine mines, otherwise they would prove harmless. All that can be said at present is that the gunboats and several small craft succeeded in forcing the boom and laying their countermines; but it is still uncertain whether the *Glatton* and the ironclad fleet which she was supposed to represent could have passed over the supposed space without bumping an electro-contact mine or being destroyed by observation charges.

About half-past 9 o'clock there was a night demonstration on a limited scale, the purpose being to ascertain the effect which the smoke from the discharge of artillery exercised upon the beam of the electric light. As is well known, the steam from a torpedo launch illumined by a strong light appears solid and opaque, but the effect upon the light itself of moving wreaths of powder smoke had not been practically tested in action. The engagement accordingly resolved itself into an artillery duel, the *Glatton*, *Medway*, and *Spey* maintaining a tremendous cannonade upon the fort, while the field battery, heavy ordnance, and infantry of the defences responded with equal vigour. Between them an abundance of smoke was produced, and as there happened to be not a breath of wind blowing at the time, the opportunity presented for observation was all that could be desired. There can be little doubt that the result was to diffuse the electric beam and to severely handicap the defence. The lamps used were Siemens's, each having the estimated illuminating power of 14,000 candles; yet notwithstanding this extraordinary energy, the smoke from the guns in their wake seemed to absorb the light to a great extent. Another effect of the diminished brilliancy appeared to be to bring out the figures of the men serving the guns and managing the lights into greater prominence. The object of the demonstration rendered the use of guard boats unnecessary, so that except from the guns the torpedo craft had it all their own way. After the smoke had cleared off a little it was perceived that several small craft had in the meantime succeeded in attaching blue lights to the boom, representing imaginary charges of gun-cotton, to be followed by imaginary but irreparable injury to the obstruction. Subsequently several torpedo craft scrambled through. They were followed by the *Medway*, apparently through the break made by the morning attack. The *Spey* afterwards attempted to run the gauntlet, and the demonstration ended with her discomfiture.

BOAT LOWERING APPARATUS.—An ingenious and effective system of boat-lowering apparatus, devised by Captain G. Lawrence, meets, as far as can be seen, all those requirements of actual service with which the inventor, as a sailor, is practically familiar. It consists of an arrangement of hinged davits, with peculiarly constructed blocks having hinged jaws. The jaws when closed are capable of holding fast a link which is attached by a short chain to each end of the boat. By means of this apparatus and its accessories a boat can be dropped at a distance from the ship's side, or sustained at that distance before dropping, should the roll of the ship necessitate such a proceeding. As a matter of fact, however, the lowering of boats, instead of being retarded by the rolling of the vessel, is really facilitated thereby, for the roll tends to throw out the hinged davits. In hooking on the boat for hoisting on board the men run no risk of damaging their hands as with heavy blocks; and the operation of hoisting, like that of lowering, is in general greatly facilitated by this apparatus. All this was clearly demonstrated by Captain Lawrence by means of a large working model which we recently inspected at 3, Fenchurch-buildings, City. The Peninsular and Oriental Steam Navigation Company have a set of this apparatus fitted on board the *Deccan*, and they have adopted a modification of the apparatus for use in raising cargo and similar operations on several other ships. This latter arrangement is also in use by the Thames Conservancy on several of the City steamboat piers for boat launching. In view of the loss of live frequently occasioned in lowering and disengaging ships' boats at sea, the present invention possesses special interest as tending, not only to diminish the risks, but to promote the rapidity of the perilous operation. By its aid it would seem that a loaded boat can be raised or lowered with facility, and released with ease and precision just when the opportune moment presents itself.

STEEL IN THE SHIPBUILDING YARD.

III.

By WILLIAM DENNY, Esq., Member of Council.

[Read at the Twenty-first Session of the Institution of Naval Architects, 19th March, 1880.]

THE first is that it never can be as efficient as testing at the manufacturers' work upon the material as rolled, because there the Surveyors can see a bending test made from each plate and bar as they are sheared or cut to length. It must also be remembered that tests can be enforced more rigidly, and will be accepted more willingly at the makers' works, upon small quantities, than in the yards upon large quantities, made costly by carriage, and certain to be made more so by return carriage. A second objection is the useless expense thrown on builders of forming a testing staff, and erecting a machine or paying for the services of a public machine, when the necessary apparatus and staff already exist and act at the makers' works. A third objection is that the shipbuilding yard is turned into a storehouse for material which cannot be immediately used, and may not be used at all. Any practical shipbuilder will readily understand the pecuniary loss and delay involved in this. A fourth objection, and the most serious, is that the delays and uncertainties involved in testing at the yards, not only tend to but actually do disorganize these establishments. In the case of my own firm, we have lost some of our best workmen through this cause.

I understand Lloyd's Committee have it under consideration to remove this very serious difficulty, and I sincerely hope they will do so.

Another difficulty in the way of steel is its supposed greater liability to corrosion than iron. Till now, upon this point, my firm's experience has been small. The *Taeping* paddle steamer built of Bessemer steel by us in 1876, has been so far reported upon most favourably in regard to the matter of corrosion. On the other hand, a small twin-screw, built by us of Siemens-Martin steel in 1878, for trading in the creeks of the lower Irrawaddy, has been reported as showing a considerable amount of pitting between the light and load water-lines, but the reports sent home are not sufficiently full to enable the cause of this pitting to be defined. It may be due to the peculiar brackish water in which the steamer was working, as compared with the fresh water in which the *Taeping* runs.

I am strongly inclined to think, however, that this case is purely local and exceptional, and the directors of the Company have adopted this view in deciding to build their latest and largest paddle steamers of the same material.

The fourth difficulty in the way of steel is the doubt entertained by some as to its reliability and safety in actual service in a ship. This doubt it will, I believe, finally and fully overcome. Our experience, already referred to, of its behaviour under manipulation ought to tell strongly in its favour, and the report on the docking and repairing of our first sea-going steel steamer, the *Rotomahana*, after running on to and over a rock, ought to convince many not only of the reliability, but of the actual safety of properly made steel. This report I have been permitted by the *Rotomahana's* owners to add to my Paper, and it will be found in full in the Appendix. Personally I am of opinion that it is a mere matter of time till steel supersedes iron, and its steadily lessening proportionate cost will undoubtedly hasten that time.

APPENDIX.

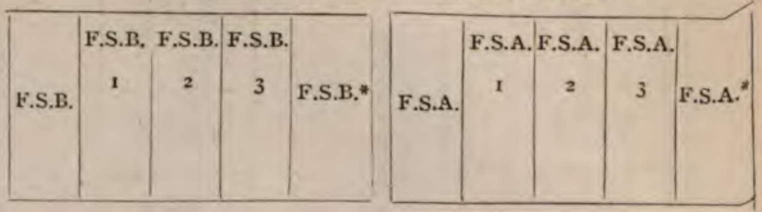
[Report of Repairs to S.S. *Rotomahana*, executed in the Graving Dock, Port Chalmers, and rendered necessary by the steamer touching on a rock while running an excursion from Auckland to the great Barrier Island, on New Year's Day, 1880.]

On examining the bottom it was found that on the starboard bilge, at the bulkhead between the forehold and the stoke-hole, about 20 feet of the fourth strake from the keel was all more or less indented, one plate particularly 14′ × 3′ 7″ × ½″ thick, being very badly indented between the frames. This plate we decided to remove, and started doing so at 7 p.m. on the 7th inst. The removal occupied twenty-four hours, as all our tools broke in the work, and a new set had to be specially made to stand the steel. The plate looked so bad that it was doubtful whether it was worth while spending any time over it; however, we decided to give it a fair trial; and it was put in the furnace and heated for two hours,

TABLE VII.—*Results of Experiments to ascertain the Tensile Strength and Ductility of Specimens cut from two forged* STEEL *Plates.*

Marks.	Dimensions.	Area.	Breaking Strain.		Elongation on 8 inches.		
	Inches.	Sq. Ins.	Actual.	Per Sq. In.	Inches.	Per Cent.	
			Tons.	Tons.			
F.S.B. 1	1·09 × ·82	·893	20·98	23·4	1·27	15·8	Imperfectly welded
F.S.B. 2	1·11 × ·82	·910	21·15	23·2	1·06	13·2	Do. do.
F.S.B. 3	1·02 × ·81	·826	19·90	24·0	1·90	23·7	
F.S.A. 1	1·01 × ·80	·808	19·37	23·9	1·75	21·8	
F.S.A. 2	1·14 × ·80	·912	22·32	24·4	1·60	20·0	
F.S.A. 3	1·06 × ·80	·848	20·40	24·0	1·80	22·5	
			Means...	23·81		19·5	

POSITION OF SAMPLES IN PLATES.



Deflection Experiments on Specimens cut from same Plates as above Samples.

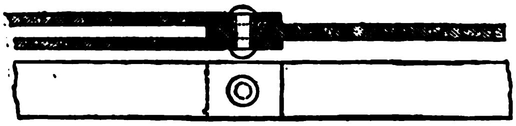
Distance apart of bearing centres, 18 inches.)

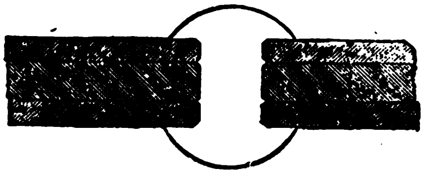
Marks	Size of Specimen.	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	10,400
F.S.A.	5" × ·775"	Set in inches ... Permanent set in ins.	None	·03 ·01	·04 ·01	·09 ·02	·23 ·12	·92 ·78	1·64 1·53	2·45 2·37	3·84 3·74	Still deflecting
F.S.A.*	4·93 × ·78"	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	9,400	
		Set in inches ... Permanent set in ins.	None	0·4	·06	·08 None	·12 ·02	·64 ·54	1·51 1·39	2·74 2·64	Still deflecting	
F.S.B.	4·9 × ·78"	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	9,020	
		Set in inches ... Permanent set in ins.	·02	·06 None	·10 ·01	·14 ·04	·20 ·10	·75 ·60	1·64 1·56	3·22 3·07	Still deflecting	
F.S.B.*	4·93 × 78"	Strain in pounds...	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9·000	9,600	
		Set in inches ... Permanent set in ins.	None	·04	·07	·10 None	·14 ·02	·50 ·36	1·3 1·11	2·2 1·98	Still deflecting	
		Mean Set... ... Mean Permanent set		·0425	·0675 ·0100	·1025 ·0300	·1725 ·0650	·7025 ·5700	1·5225 1·3975	2.6525 2·5150		

TABLE VIII.

Experiments on the Shearing Strength of Rivets—Steel and Iron—one Rivet in each Specimen subject to double-shearing action.

Hand Sketch of Specimens—

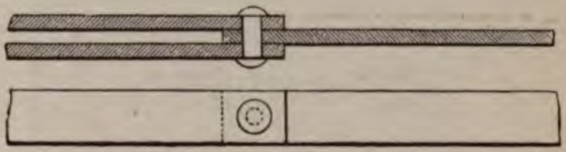


	Diameter of Hole.	Area of Hole.	Double Area of Hole.		Shearing Force.		
					Total.	Per Sq. In.	
	Ins.	Ins.	Sq. Ins.				
¾-in. Steel Rivets made from Homogeneous Steel.	·82	.528	1·056	Riveted by Arroll's Hydraulic Machine.	25·40	24·0	Sheared on both surfaces.
	”	”	”		26·52	25·1	Sheared on one surface.
	”	”	’	Riveted by Hand.	23·44	22·2	Sheared on both surfaces.
	”	”	”		21·70	20·5	Sheared on one surface.
¾-in. Steel Rivets made from Scrap Steel.	·82	·528	1·056	Hydraulic	24·60	23·3	Sheared on one surface.
	”	”	”		25·44	24·1	” ”
	”	”	”	Hand	21·96	20·8	” ”
	”	”	”		22·85	21·6	” ”
¾-in. Iron Rivets made from Best Scrap Iron.	·805	·509	1·018	Hydraulic	20·05	19·7	Sheared on both surfaces.
	·810	·515	1·03		19·82	19 2	Sheared on one surface.
	·815	·522	1·044	Hand	19·55	18·7	Sheared on both surfaces.
	”	”	”		20·09	19·2	” ”
Holes in next four slightly countersunk, thus :— 							
¾-in. Scrap Steel Rivets.	·80	·503	1·006	Hydraulic	25·00	24·8	Sheared on one surface.
	.,	”	”		25·09	24·9	Sheared on both surfaces.
	8·15	·522	1·044	Hand	26·16	25·1	Sheared on one surface.
	.80	·503	1·006		24·42	24·3	” ”

All the holes in the above were drilled.

TABLE IX.

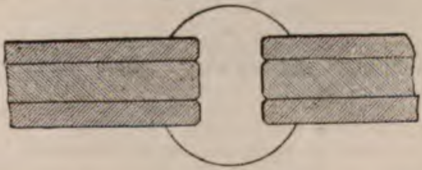
Experiments on the Shearing Strength of Rivets, Steel and Iron, one Rivet in each Specimen subject to double shearing action.



	Diameter of Holes.	Area of Holes.	Double Area of Holes.		Shearing.		
					Total.	Per Sq. In.	
	Ins.	In·.	Sq. Ins.				
¾-in. Steel Rivets made from Homongeneous Steel.	·825	·535	1·07	Hydraulic	26·25	24·5	Sheared on both surfaces.
	·815	·522	1·044		25·93	24·8	" "
	·825	·535	1 07	Hand	27·36	25·6	Sheared on one surface.
	·815	·522	1·044		26·03	24·9	" "
¾-in. Steel Rivets made from Scrap Steel.	·815	·522	1·044	Hydraulic	23·84	22·8	Sheared on both surfaces.
	"	"	"		24·11	23·1	" "
	"	"	"	Hand	23·08	22·1	" "
	"	"	"		22·95	22·0	" "
¾-in. Iron Rivets made from Best Scrap Iron.	·815	·522	1·044	Hydraulic	19·69	18·9	Sheared on one surface.
	"	"	"		20·18	19·3	Sheared on both surfaces.
	·82	·528	1·056	Hand	20·40	19·3	Sheared on one surface.
	"	"	"		*18·66	17·7	" "

* Rivet fractured also between the shearing surfaces as by tensile strain.

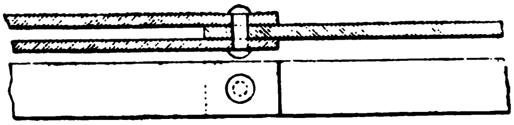
Holes in next four slightly countersunk, thus:—



	Diameter of Holes.	Area of Holes.	Double Area of Holes.		Shearing. Total.	Shearing. Per Sq. In.	
¾-in. Scrap Steel Rivets.	·825	·535	1·07	Hydraulic	24·86	23·2	Sheared on one surface.
	·815	·522	1·044		25·36	24·3	" "
	·825	·535	1·07	Hand	24·55	22·9	" "
	·82	·528	1·056		26·30	24·9	" "

All the holes in the above were drilled.

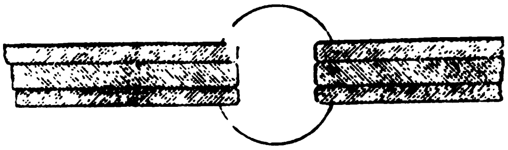
TABLE X.—*Experiments on the Shearing Strength of Rivets—Steel and Iron—made by combining results given in Tables VIII. and IX. One Rivet in each Specimen subject to double-shearing action.*



	Diameter of Holes.	Area of Holes.	Double Area of Holes.		Shearing Force.		Means.	Means.
					Total.	Per Sq. In.		
	Ins.	Ins.	Ins.					
¾ in. Steel Rivets made from Homogeneous Steel.	·82	·528	1·056	Riveted by Arrol's Hydraulic Machine	25·40	24·0	24·55	24·6
	„	„	„		26·52	25·1		
	·825	·535	1·07		26·25	24·5	24·65	
	·815	·522	1·044		25·93	24·8		
	·82	·528	1·056	Riveted by Hand.	23·44	22·2	21·35	23·3
	„	„	„		21·70	20·5		
	·825	·535	1·07	„	27·36	25·6	25·25	
	·815	·522	1·044		26·03	24·9		
¾ in. Steel Rivets made from Scrap Steel.	·82	·528	1·056	Hydraulic	24·60	23·3	23·7	23·3
	„	„	„		25·44	24·1		
	·815	·522	1·044	„	23·84	22·8	22·95	
	„	„	„		24·11	23·1		
	·82	·528	1·056	Hand	21·96	20·8	21·2	21·6
	„	„	„		22·85	21·6		
	·815	·522	1·044	„	23·08	22·1	22·05	
	„	„	„		22·95	22·0		
¾ in. Iron Rivets made from best Scrap Iron.	·805	·509	1·018	Hydraulic	20·05	19·7	19·45	19·3
	·810	·515	1·030		19·82	19·2		
	·815	·522	1·044	„	19·69	18·9	19·1	
	„	„	„		20·18	19·3		
	·815	·522	1·044	Hand	19·55	18·7	18·95	18·7
	„	·522	„		20·09	19·2		
	·82	·528	1·056	„	20·40	19·3	18·5	
	„	„	„		18·66	17·7*		

* Fractured also between the shearing surfaces as by tensile strain.

Holes in next eight slightly countersunk, thus :—



¾ in. Steel Rivets made from Scrap Steel.	·80	·503	1·006	Hydraulic	25·00	24·8	24·85	24·3
	„	„	„		25·09	24·9		
	·825	·535	1·07	„	24·86	23·2	23·75	
	·815	·522	1·044		25·36	24·3		
	·815	·522	1·044	Hand	26·16	25·1	24·7	24·3
	·80	·503	1·006		24·42	24·3		
	·825	·535	1·07	„	24·55	22·9	23·9	
	·82	·528	1·056		26·30	24·9		

TABLE XI.—OCEAN STEAMERS CLASSED AT LLOYD'S.
Averages of STEEL *Tests.*
(Rejected Plates or Bars not included.)

No. of Ship.	Angles or Plates.	Breaking Strain Per Sq. In.	Elongation per cent. on 8 Inches.
		Tons.	
224	Angles, &c. ...	28·2	25·3
,,	Plates	29·0	21·9
,,		28·6	23·6
225	Angles, &c. ...	28·80	22·70
,,	Plates	29·65	22·53
,,		29·225	22·615
226	Angles, &c. ...	30·208	21·67
,,	Plates	29·27	21·58
,,		29·739	21·625
233	Angles, &c. ...	29·41	23·38
,,	Plates	28·46	22·16
,,		28·935	22·77
Grnl. avge.	... ...	29·125	22·652

then taken out and hammered on the blocks. This process had to be repeated three times before the rollers would take it in, but when it had passed through the rollers it really looked like a new plate perfectly sound and good. In working it stretched $\frac{3}{16}$ths of an inch, but by paring a little off the ends, the rivet holes at both the landings and the butts, came in exactly as required for a fine fit. Seven of the frames were badly bent, with a sharp curve tending both inwards and aft, two being bulkhead frames, with double angles and very strong.

The floors were cut and the frames thoroughly examined, but we found no sign of crack or strain in the material. The frames were heated and restraightened and riveted to the floors. All the riveting was completed by six p.m. on the 10th inst. It may be here stated that had the frames been composed of iron, instead of the splendid ductile material of which they are composed, they would all require to have been renewed, and even then they would not have made such a complete job as the present. The ironwork inside was cemented, and the ceiling laid and bolted down as before. The bottom was coated with McBean's anti-fouling composition, and the top sides repainted.

The steamer was safely floated out of dock on the 10th inst., at eleven p.m., and sailed for Melbourne at five p.m. next day.

15th January, 1880.

(*Signed*) A. CAMERON,
Marine Superintendent.

EXTRACT FROM LETTER OF MANAGING DIRECTOR OF THE UNION STEAMSHIP COMPANY OF NEW ZEALAND REFERRING TO THE "ROTOMAHANA'S" TOUCHING ON A ROCK.

"This experience has shown clearly the immense superiority of steel over iron. There is little doubt that had the *Rotomahana* been of iron, such a rent would have been made in her that she would have filled in a few minutes. A number of frames were set back by the force of the blow, the bulkhead was bulged and the plate was corrugated, and yet there did not appear one crack anywhere. We would, however, require better tools than we have at present if we are to have anything further of this nature, as the steel proves very difficult to work."

ON THE STEAM-SHIP "CITY OF ROME."

Paper read before the Institution of Mechanical Engineers, at Barrow,

By Mr. JAMES HUMPHRYS, of Barrow-in-Furness.

THE following paper is a brief description of the great steam-ship for the Inman line, which is now to be seen in course of construction on the stocks of the Barrow Shipbuilding Company.

Perhaps the spirit and enterprise of British commerce have never been more fully illustrated than in the wonderful development of the mercantile marine in recent years. In 1870 the total tonnage of British steam-shipping was 1,111,375 tons, but the returns for the year 1876 show it to have increased to 2,150,302 tons; and from that time to the present it has been increasing still more rapidly. Not only has the total tonnage increased to this enormous extent, but the advance that has been made in increasing the size of vessels has been immense; and in no quarter has this feature been more remarkable than in the great passenger lines of the Atlantic. One of the foremost amongst these has always been the Inman line, which already possesses in the *City of Berlin* the vessel of largest tonnage at present in existence, with the exception of the *Great Eastern;* and whose steamers, with their high speed and excellent accommodation, are inferior to none in the world for the comfort and convenience of passengers.

With a view of still further providing for the comfort and swift transport of the rapidly increasing numbers who cross the Atlantic between New York and Liverpool, the Inman Steamship Company decided some little time since to order a vessel which should combine the highest rate of speed with the maximum of comfort and luxury: a speed but little inferior to that of railway travelling, and luxury and comfort such as can be found only in the most completely appointed modern hotels.

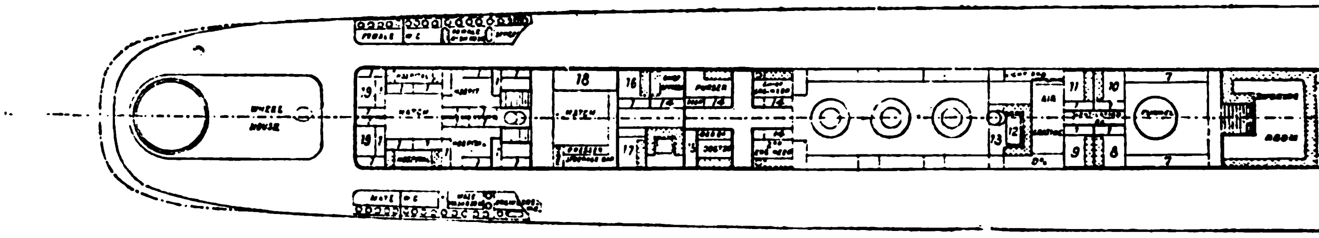
To fulfil these conditions, it was deemed necessary that the vessel should be of very much greater dimensions than any ship then belonging to the Company; and after the most careful deliberation it was considered advisable to go to a size of at least 8000 tons. The dimensions finally adopted were, length between perpendiculars, 546 ft.; length over all, 600 ft.; extreme breadth, 52 ft. 3 in.; depth of hold, 37 ft. The great length as compared with the breadth ensured long easy lines for the high speed required; and the depth of hold being only 37 ft., as compared with the beam of 52 ft., ensured great stability and consequent comfort for the passengers.

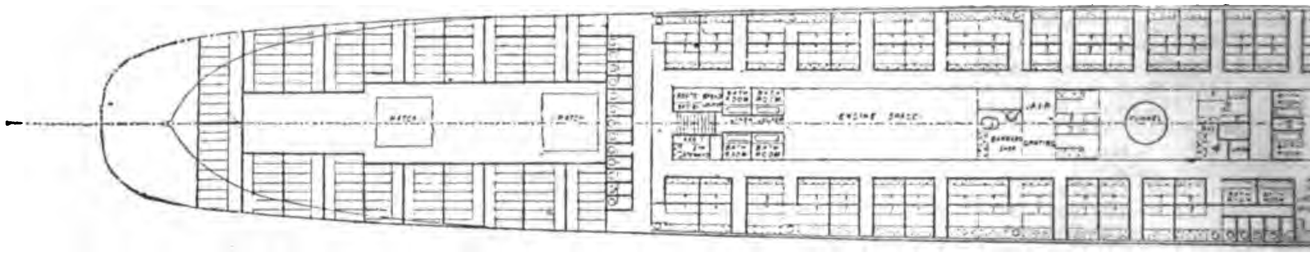
GENERAL FEATURES.—It will be seen that the distinctive type of the Inman line has not been departed from in respect of the perhaps old-fashioned but still handsome profile, with clipper bow-figure-head, and bowsprit. For the figure-head is proposed a full-length figure of one of the Roman Cæsars, in the imperial purple. The whole of the headwork, with this exception, will be formed in iron, to save the cost and trouble of continually renewing the head-rails, &c., when made of wood.

The vessel is to be rigged with four masts; and here again the handsome full ship-rig of the Inman line has been adhered to, with the addition of the four-and-aft rigged jigger-mast, rendered necessary by the enormous length of the vessel. She will have three funnels, each painted with the Company's white band. The profile drawing, gives a view of the general arrangement of the vessel, of her four complete tiers of beams, and of the run of the promenade and turtle decks, with the hurricane deck-house towering above all. A point calling for special notice is the large number of separate compartments formed by water-tight bulkheads, each extending to the main deck. The largest of these compartments are only about 60 ft. long; and supposing that, from collision or other cause, one of these was filled with water, the trim of the vessel would not be materially affected.

With a view of giving still further safety in the event of collision or stranding, the boilers are arranged in two boiler-rooms, entirely separated from each other by means of a water-tight iron bulkhead. This reduces what in nearly all full-powered steam-ships is a vast single compartment into two of moderate size, 60 ft. in length; and in the event of either boiler-room being flooded, it still leaves the vessel with half her boiler power available, giving a speed of 13 or 14 knots per hour. There is also the usual water-tight bulkhead separating the engine-room from the after boiler-room. Another feature of great importance is the disposition of the boilers. They are eight in number, of the double-ended form, and arranged fore and aft in four blocks of two, with the transverse bulkhead already mentioned between the central blocks. This arrangement provides for the bulk of the coal being carried in the sides of the vessel; and advantage is taken to make the bunkers form part of the structure. They extend in a straight line the entire length of the space occupied by the engines and boilers; and, being in the same line with the outer side keelsons, they are incorporated with them, forming two strong longitudinal girders. These add considerably to the strength of the ship in the most important part, where in many vessels there is rather a loss than an accession of strength. It is intended further to make these bunkers and keelsons water-tight, and so to form an inner skin, which will afford admirable protection to the boilers and machinery in case of the vessel being cut into amidships—an accident that in ordinary vessels almost invariably causes instant foundering. These bunkers, and all the bulkheads, are fitted with proper water-tight doors, which will be of the type adopted by the Admiralty. These will be worked both from the main-deck and from below, and will be fitted with tell-tales on deck, to show clearly whether they are open or closed.

S. S. “


WHEEL HOUSE
18
16
17
19
13
12
11
10
9
8
7
1. BERTHS, TWO TIERS
2. D° THREE "
3. CARPENTER & MATE.
4. BOATSWAIN & MATE
5. QUARTER-MASTERS
6. BOATSWAINS LOCKER
7. LIGHT & VENTILATION TO CABIN PASSAGE
8. CHIEF & 2ND CLERK
9. 3RD & 4TH ENGINEERS
10. 5TH & 6TH ENGINEERS
11. 7TH 8TH & 9TH ENGINEER
12. TABLE
13. ENGINEERS MESS ROOM
14. BED DRAWERS
15. DISPENSARY
16. 3RD 4TH & 5TH OFFICER
17. 2ND OFFICER
18. STEERAGE FOR DELIVERY STORE
19 STEERAGE STEWARDS


HATCH
HATCH
ENGINE SPACE
FUNNEL
1. BERTHS TWO TIERS
2. FAMILY ROOMS
3. ASH. SHOOT
4. STEWARDESS
5. SCULLERY.
6. CHIEF STEWARD
7. STEWARDS CLOSET

At the fore end a double bottom has been arranged for a distance of 150 ft. from the stem. This will add greatly to the safety of the ship in the event of her stranding on a rock or suffering a bow-on collision, as the bow is thereby greatly strengthened, and the risk of water getting into the vessel reduced. The sizes of the forward compartments generally are also small compared with the general dimensions. Constant care had thus been taken in working out the arrangements, to provide as far as possible against the dangers of collision or other accident.

Structural Details.—The stern frame or post, now making at the Mersey Steel and Iron Works, will be the largest single forging ever made for such a purpose: the finished weight is estimated to be not less than 33 tons, as compared with 18 tons in the stern post of the *Furnessia*, of 5500 tons, also building in the yard.

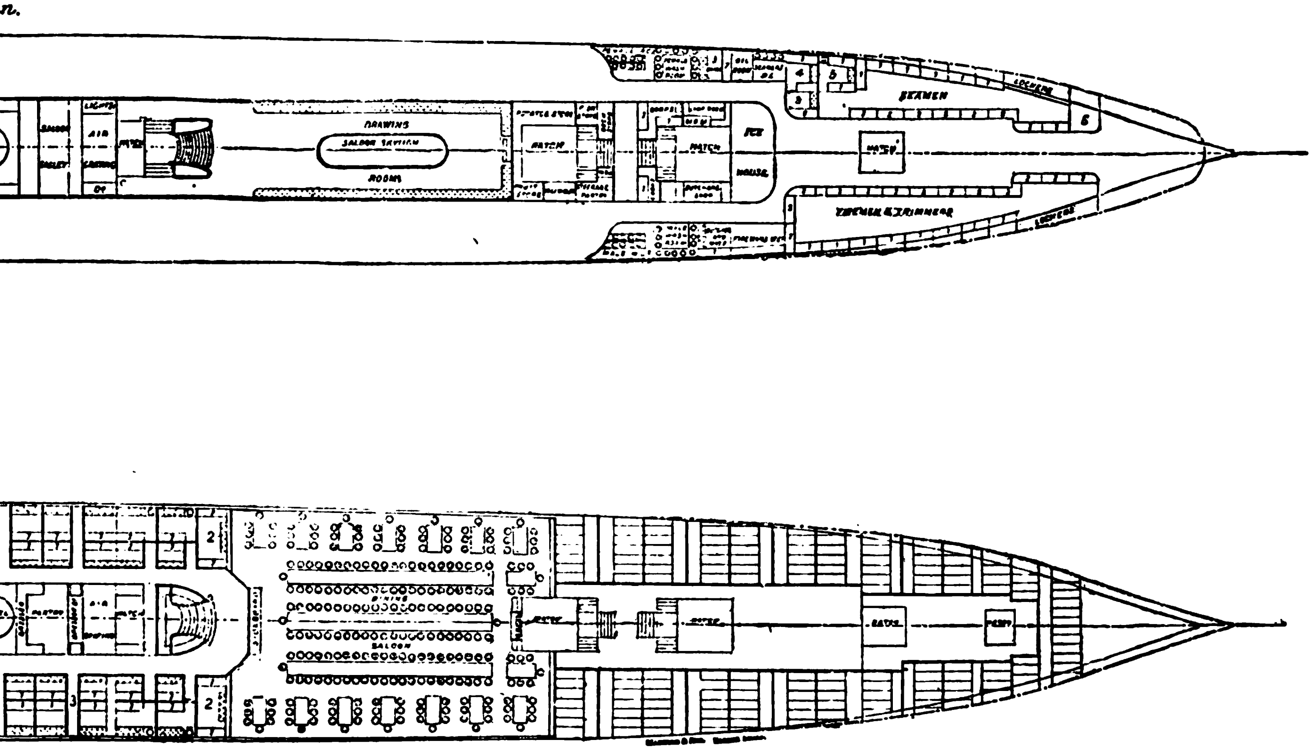
The framing of the vessel is of the ordinary type, the floors being 34 in. deep at the centre line. The frames are in one length from centre line to gunwale, and are of angle-irons 7 in. × 4 in., and 60 ft. in length. The reverse frames are also in one length of 4 in. × 4 in. angle-iron. The butts of the frames, reverse frames, and floors, are all carefully shifted from one another. The whole of the beams are of the Butterley bulb sections, each rolled in one length. The vessel has two complete iron decks above; while the lower deck is complete for half the length, and has wide plating on each side for the remainder. She has nine tiers of keelsons, all running right fore and aft; the five central ones are of uniform height, so as to be carried unbroken through the engine and boiler seatings.

The shell plating is arranged on a principle that has been applied with great success to all the large transatlantic steamers which have been built in Barrow. The inside plates form a complete skin, fitted accurately edge to edge and butt to butt, with covering-plates, half the width of the inside strakes, fitted outside. By this arrangement the shearing strains on the riveting are greatly diminished; and the plating in the way of the outside covering strakes being doubled, thinner plates are used than the ordinary mode of plating as per Lloyd's rules, and so much sounder and closer work is ensured.

The hold stanchions are arranged in two tiers, one on each side, the better to support and strengthen the long beams.

The whole of the deck-houses, turtle-decks, and other erections on the upper deck are of iron, to stand the strains of an Atlantic winter. The scantlings had to be considered specially, and have been approved both by Lloyds' and by the Liverpool Registry, the vessel being built under the special surveys of both societies for the highest class of ocean steamers.

ROME."



ENGINES AND BOILERS.—The question of propelling this great vessel at so high a speed as it is anticipated will be obtained—namely 18 knots per hour—was one that demanded long and very careful consideration. It was ultimately decided that it would be better to adhere to the single-screw arrangement, and to adopt a propeller 24 ft. in diameter, driven by three sets of what are technically known as inverted "Tandem" engines, working on three cranks disposed at an angle of 120 degrees with one another

The "tandem" engine, as is well known, has the high-pressure cylinder placed in a line behind or above the low-pressure cylinder. This arrangement was adopted in preference to other types of three-crank engines, in which the powers developed are not so uniform, in order that absolutely equal efforts might be given out by each of the three engines, thus ensuring a perfectly-balanced and evenly-working machine: it is expected that when these engines are nicely adjusted, they will work almost without noise.

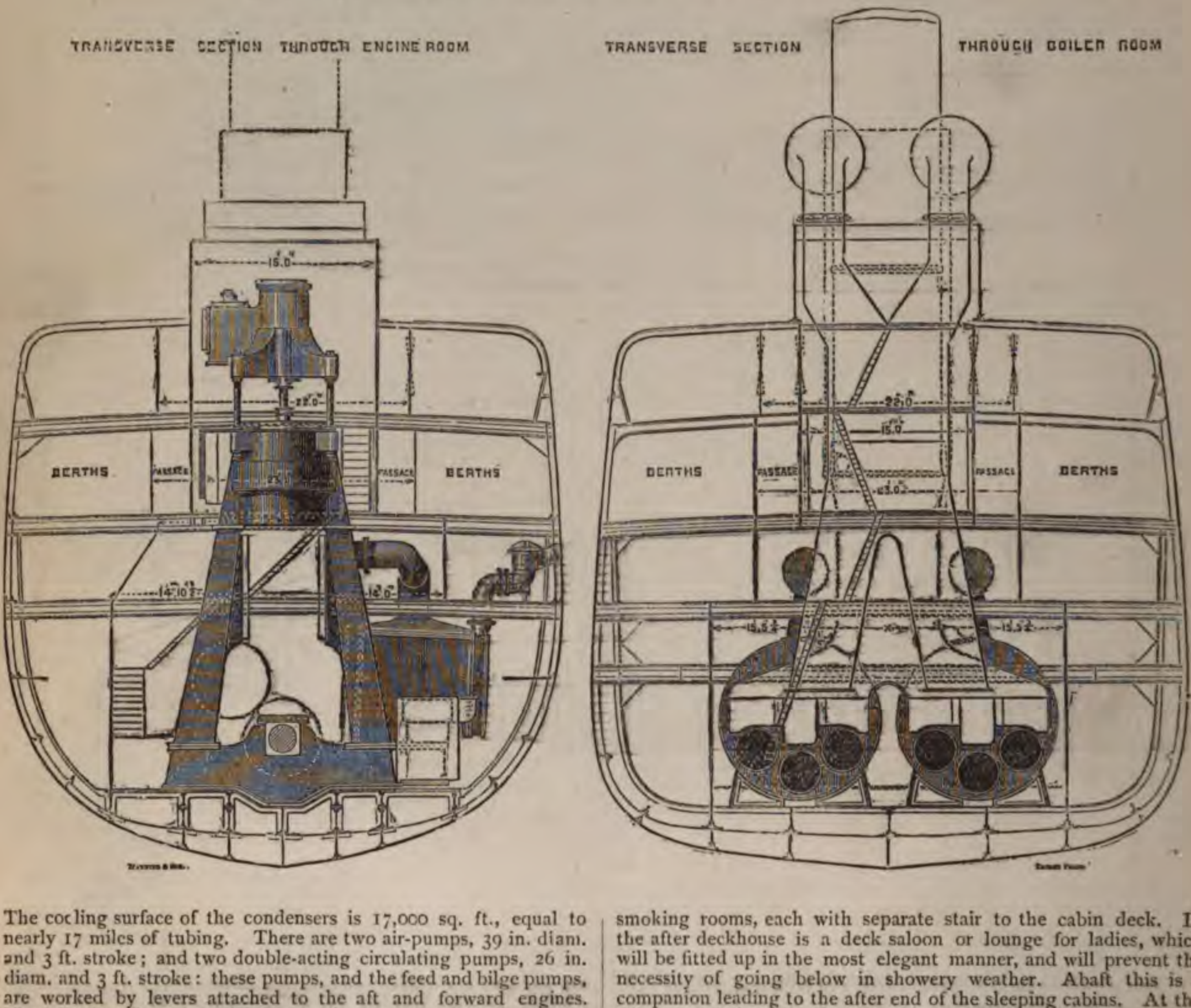
Each high-pressure cylinder is carried upon three wrought-iron columns, thus giving plenty of light and easy access to the stuffing-boxes; and also enabling the cylinder covers, which are made in halves, to be readily withdrawn, should it be desired to examine or repair the cylinders or pistons. The slide-valves are driven by an independent shaft, worked by two pairs of mortice wheels, one at each end of the engines; an arrangement which has the advantage of requiring comparatively small eccentrics. Moreover, as the valve faces are disposed towards the front of the engines, this arrangement makes them very accessible.

The crank-shaft is to be a built shaft, and, together with the screw shafting, is being made by Sir Joseph Whitworth & Co., of their fluid-compressed steel. The shafting is made hollow, and by the following process, which must ensure perfect soundness. Each length is made from a hollow cylindrical ingot, which, while in the molten state, is subjected to a heavy hydraulic pressure, thus ensuring the exclusion of all gases, and thoroughly consolidating the entire mass. The ingot is afterwards re-heated and placed on a mandril; and is then forged and drawn by hydraulic pressure, until it ultimately assumes the form of a double-collared shaft. This process, in the writer's opinion, is the only one that can ensure really sound and perfect shafting.

The leading particulars of the engines are as follows:—

There are three high-pressure cylinders 43 in. diam., and three low-pressure cylinders 86 in. diam., all 6 ft. stroke. The diameter of the crank-shaft is 25 in., and of the crank-pins 26 in. The length of the main bearings is 33½ in., and of the crank-pins 28 in. The crank-shaft, as built up complete, will weigh 64 tons; had it been made of iron and solid, the weight would have been 73 tons. The propeller shafting is 24 in. diam., and the hole through it 14 in. diam. The thrust shaft has thirteen collars, 39½ in. diam., giving a surface of 6000 sq. in. This piece of shafting will weigh 17 tons. The propeller shaft is 25 in. diam., and 30½ ft. long, and will weigh 18 tons. The engine bed-plate will weigh 100 tons.

ENGINES OF THE S.S. CITY OF ROME.



TRANSVERSE SECTION THROUGH ENGINE ROOM

TRANSVERSE SECTION THROUGH BOILER ROOM

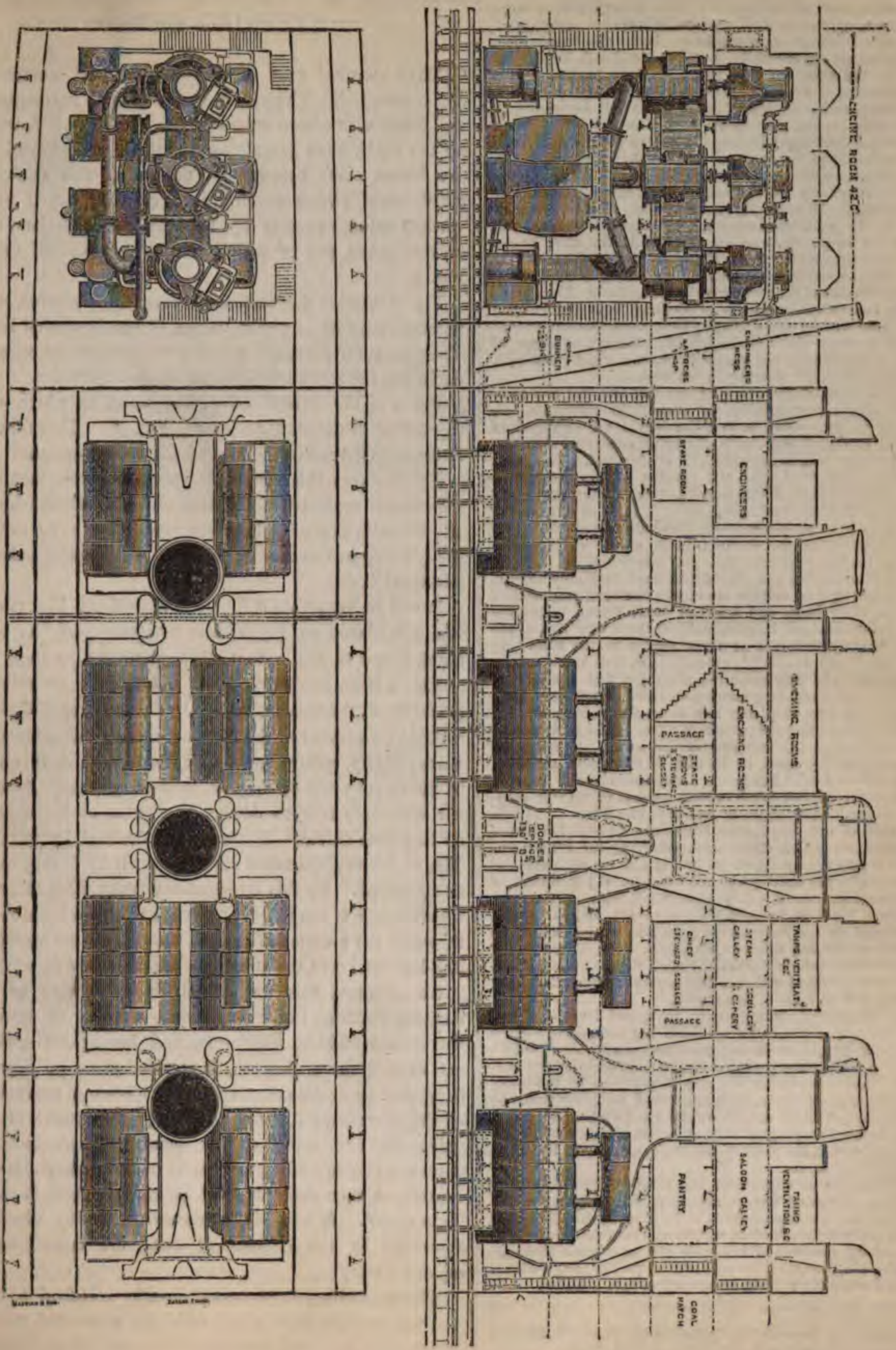
The cooling surface of the condensers is 17,000 sq. ft., equal to nearly 17 miles of tubing. There are two air-pumps, 39 in. diam. and 3 ft. stroke; and two double-acting circulating pumps, 26 in. diam. and 3 ft. stroke: these pumps, and the feed and bilge pumps, are worked by levers attached to the aft and forward engines. There is also a large centrifugal pumping engine, which can either be used for pumping heavy leaks or can also discharge through the condenser. There are also three auxiliary pumping engines, for feeding the boilers, for bilge pumping, and for deck purposes.

Steam is supplied by eight cylindrical tubular boilers, fired from both ends. Each boiler is 14 ft. mean diameter, and 19 ft. long, with a steam receiver 13 ft. long and 4 ft. diam.; and has six furnaces 3 ft. 9 in. diam., three at each end; so that there are forty-eight furnaces in all. The fire-bars are 6 ft. long, giving a grate surface of 1080 sq. ft. The shell plates of the boilers, supplied by Sir John Brown & Co., are 24 ft. 8 in. long, 4 ft. 4½ in. wide, and 1¼ in. thick, and weigh nearly 2½ tons each; all the holes are drilled. The internal parts are of Bowling iron; and each furnace has its own separate combustion chamber. These boilers are constructed for a working pressure of 90 lbs. per sq. in.

The engines are intended to work constantly at 8,000 indicated horse-power, although they are capable of developing 10,000 horse-power indicated.

INTERNAL ARRANGEMENTS.—The general arrangements of the passengers' and officers' quarters, &c., are indicated by the plans. The promenade deck carries at the fore end the saloon skylight. In the hurricane deck-house the captain's and chief officer's cabins are placed close to the steering-house and look-out bridge, so that they are always near in case of necessity. Abaft this is the upper saloon companion, and abaft this again the large upper smoking room, which is a novel feature in this ship; it being thought advisable, in view of the large number of passengers, to fit two smoking rooms, each with separate stair to the cabin deck. In the after deckhouse is a deck saloon or lounge for ladies, which will be fitted up in the most elegant manner, and will prevent the necessity of going below in showery weather. Abaft this is a companion leading to the after end of the sleeping cabins. At the sides of this hurricane deck will be carried twelve lifeboats, one of which will be fitted as a steam launch. On this deck are the steam-winches for working the cargo.

On the upper deck, commencing at the fore end, is the steam-windlass for working the anchors and cables; and in the compartments on each side of the bow, accommodation is provided for the crew and firemen. At the after end of the turtle deck are all the washhouses and other fittings for the accommodation of the emigrants in the forward part of the vessel, together with cabins for the petty officers and stores, &c., for the ship. Next comes the upper saloon, or drawing-room, for the use of passengers. This


ENGINE ROOM 42'0"
BUNKER
ENGINEERS MESS
SPARE ROOM
ENGINEERS
SMOKING ROOMS
SMOKING ROOMS
PASSAGE
STATE ROOMS & STEWARDS
BUNKER SPACE
CHIEF STEWARD
STEAM GALLEY
PASSAGE
FANS VENTILATN &C
PANTRY
SALOON GALLEY
FANS VENTILATION &C
COAL HATCH

GENERAL ARRANGEMENT OF ENGINES AND BOILERS OF S.S. CITY OF ROME.

apartment, which will be fitted up very handsomely with lounges round the sides, is in the form of a wide gallery with a large rectangular opening into the dining saloon below, thus giving great height and light to the latter apartment. Above this opening is a large skylight, richly ornamented; at the fore end will be a grand piano, and at the after end the grand staircase leading to the dining-room below. Proceeding aft we come to the galleys, sculleries, bakery, and other offices, all of which will be fitted with the best cooking ranges, &c. Next is the lower smoking room, which will be fitted similarly to the upper; the panelling of these rooms will probably be in wainscot oak, the floors laid in mosaic pavement; and the upholstery in morocco leather. Abaft this are the rooms for the officers and engineers, which, being exceptionally large and lofty, will be unusually comfortable. Under the after turtle deck is the accommodation for hospitals, lavatories, and other offices for emigrants, who are berthed in the after 'tween decks. At the extreme after end is the wheel-house, where will be placed the steam-steering gear, with a very strong hand-steering gear, to be used in case of the steam gear breaking down. The steam-gear will be controlled by means of shafting from the bridge; from which there will be also a telegraphic communication, should it be desired to steer the vessel from aft. A large quadrant of wrought iron is attached to the rudder stock, and is provided with deep grooves in which the steering chains work.

On the main deck, commencing at the fore end, are two compartments for the accommodation of about 260 emigrants. A special feature in this vessel is that the berths are arranged in single instead of double tiers, each tier being separated from the next by a passage with large sidelight at the end. This adds greatly to the ventilation, light, and comfort of the passengers. The height in the 'tween decks is 9 ft. Next comes the grand dining saloon, 72 ft. long, 52 ft. wide, and 9 ft. high, or 17 ft. in the way of the large opening through the drawing-room above. This opening, surmounted by the skylight, forms a very effective and elegant relief to the otherwise flat and heavy ceiling. It is intended that the paneling and decorations shall be highly artistic, and quite unique; special designs are now in course of preparation. There will be three large and fourteen small dining tables, the large tables being arranged longitudinally in the central part of the saloon, and the small tables at right angles in the sides; an arrangement that will enable the attendants to wait more readily on the diners, and will also break the monotony that would exist if all the tables presented long continuous rows of people. Each diner will have his own revolving arm-chair, and accommodation will be provided for seating 248 persons at once. A large American organ will be fixed at the fore end of this room. Opening off through double spring doors is the foot of the grand staircase, under which will be fixed a handsome American luncheon bar with the usual fittings; beyond is the saloon pantry, which will communicate with the kitchen above by means of two lifts.

On each side of the vessel, from the saloon to the after end of the engine room, are placed state rooms providing for 271 passengers. These rooms are arranged in two blocks on each side, an inner and an outer; the outer rooms are 6 ft. 6 in. × 7 ft. 6 in., and the inner rooms 6 ft. 6 in. × 5 ft. 9 in., both 9 ft. high. In the outer rooms the lower berth is made to slide in or out, while the berth above is arranged on the Pullman-car principle, so that it can be folded up out of the way when required—an arrangement which will be much more comfortable than the usual ships' sleeping berth. The inner rooms are fitted with the ordinary bed places, and light will be furnished from a 14-in. side scuttle.

Amidships are placed retiring-rooms, baths and lavatories, barber's shop, &c. Abaft the cabin bulkhead the main deck is fitted for about 240 emigrants, in the same manner as for those forward; accommodation is therefore provided on the main deck for 500 emigrants in all. Accommodation can also be provided on the lower deck for 1,000 emigrants more, making a grand total of 1,500. In way of the engine and boiler casings will be fitted up the mail room, specie room, and the passengers' luggage room, all opening off the main deck; and along the sides of the engine-room will be berths for the saloon stewards, &c.

In concluding the description of this great steamer, it may be stated that her estimated weight, complete and ready for sea, is 8,000 tons, and that her displacement, at 26 ft. mean draft, is 13,500 tons; so that she will have a dead-weight carrying power of 5,500 tons. The cubical contents of her holds will give her a measurement capacity of 7,720 tons, at 50 cubic ft. to the ton. She is expected to be ready for work in the course of next summer.

THE *Italia*, one of the colossal ironclads in course of construction by the Italian Government, will be launched in October.

HARRISON'S PATENT NOISELESS STEAM STEERING GEAR.

THIS steering gear is very simply and compactly arranged. The cylinders are placed horizontally, and fitted with piston valves in the usual way. A worm on the crank shaft gears into a worm wheel, keyed on the barrel shaft below. On the end of this shaft is a small bevel pinion gearing into a wheel keyed on a vertical spindle passing up between the cylinders, and on the forked end of which is fitted the cut-off valve, Fig. 2.

Fig. 1 shows the stationary face of the valve, with passages leading to piston valves, shown by dotted lines. The two outer ports are steam ports, the central exhaust enclosing the forked end of cut-off valve spindle.

Fig. 2 is the cut-off valve, the ports in which correspond with the stationary face, Fig. 1. Three holes in the centre receive the end of the forked spindle.

Fig. 3 shows the admission valve, the movements of which are regulated by the steersman. It has but a single steam port, A (the other port, shown by dotted lines, being in communication with the central exhaust passages).

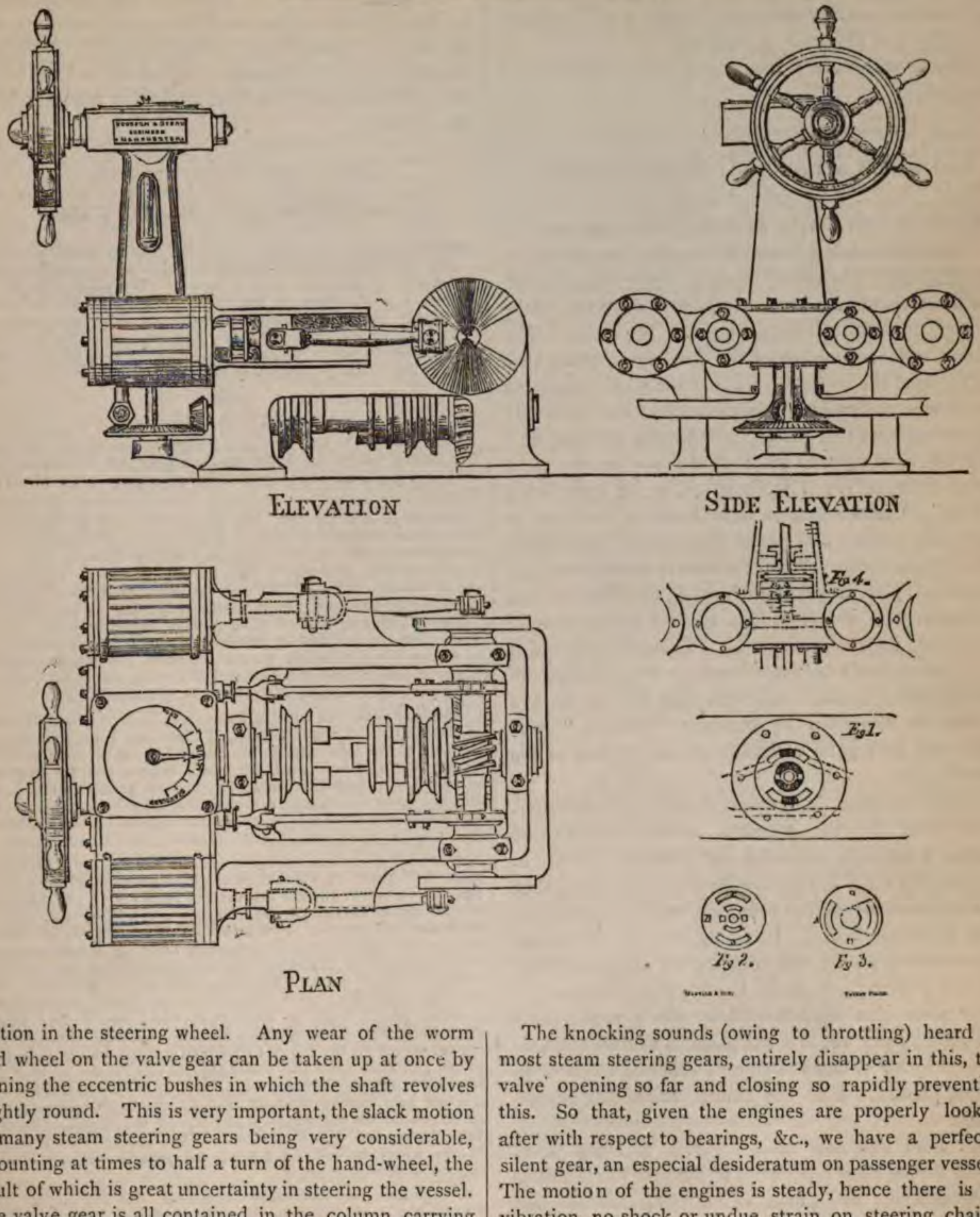
It will be seen that if Fig. 2 is placed on Fig. 1, and Fig. 3 is placed on Fig. 2, with its steam port, A, over blank space B, Fig. 2, that all the ports are covered.

Fig. 4 is an elevation of the valves in their relative positions in the valve case. On the helmsman making a slight movement of the steering wheel, the admission valve, Fig. 3, rotates and opens steam port A to either of the steam ports on Fig. 2, admitting steam through the stationary face to dotted line passages below, and so to piston valves. If steam is admitted by port C, Fig. 2, the engines move say to port; if by D they move to starboard. By this arrangement (even after allowing a sufficiency of lap to prevent waste of steam by blowing through) the steering is perfect, the engines answering to one-half spoke of the steering wheel in either direction.

To illustrate this we will divide the motion of the steering wheel and of the valve into degrees of motion, the wheel making five turns, and having six spokes, call each spoke a degree of motion, gives 30 degrees from port to starboard. The corresponding movement of the valve is 7½″, giving exactly ¼″ movement of the valve for one spoke of the steering wheel, and, of course, a corresponding movement of the engines. It will be seen at once that this gives great advantages in steering a vessel. A very slight movement of the wheel is answered by the engines at once, the cut-off being equally prompt.

The controlling valve being directly attached to the vertical spindle does away with the wear and tear of levers, pins, &c., and precludes the possibility of slack

HARRISON'S PATENT NOISELESS STEAM STEERING GEAR.



motion in the steering wheel. Any wear of the worm and wheel on the valve gear can be taken up at once by turning the eccentric bushes in which the shaft revolves slightly round. This is very important, the slack motion in many steam steering gears being very considerable, amounting at times to half a turn of the hand-wheel, the result of which is great uncertainty in steering the vessel. The valve gear is all contained in the column carrying the hand wheel; the base forms the valve case. It can be removed intact, and enables an ordinary mechanic to take out the valves for examination, and replace them in working order in a few minutes, a great consideration when at sea.

The knocking sounds (owing to throttling) heard in most steam steering gears, entirely disappear in this, the valve opening so far and closing so rapidly preventing this. So that, given the engines are properly looked after with respect to bearings, &c., we have a perfectly silent gear, an especial desideratum on passenger vessels. The motion of the engines is steady, hence there is no vibration, no shock or undue strain on steering chains, rods, &c. Steering by this gear is as steady as if by hand only, the engines following the motion of the hand wheel in either direction with instant precision, enabling any seaman to steer the vessel without previous practice with steam steering gear.

This patent has, amongst others, been fitted on the following steamers:—s.s. *Barnsmore*, s.s. *Rossmore*, s.s. *Craigmore*, s.s. *Canopus*, s.s. *Duke of Buckingham*, s.s. *Laurium*, s.s. *Mokta*, s.s. *Tafna*, p.s. *Gamecock*, p.s. *Daisy*, p.s. *Primrose*, p.s. *Oxton*.

The sole makers are Hodgson & Stead, Limited, of Manchester.

VAUCHER'S PATENT WOVEN HOSE.

THERE are no details so trifling that they are not worth the closest attention in order to produce a perfect whole. The whole safety of a ship may depend upon the perfection and instant readiness for action of the fire appliances with which she may be fitted. The qualities and construction of the fire engine pump may have received the best attention, but the whole apparatus may become useless by the inefficiency of the hose. It may be supposed that the ordinary leather fire hose may always be relied upon to be ready for use on the most sudden emergency. This, however, is far from being the case. Leather hose is most liable to crack, as it will rapidly harden and stiffen from disuse, particularly under a tropical sun. When the hose is then moved and brought into play, it will at once crack, and thus prevent the discharge of a proper jet. Such a leather hose is united along its whole length by a rivetted seam, which is at all times liable to come loose by the breaking off of rivet-heads. Leather hose can thus only be kept in an effective condition by constant "dubbing" with grease, and by regular attention to the security of the rivetted joint.

A much cheaper and more reliable substitute for leather hose is the seamless woven canvas hose (Vaucher's patent), supplied by Messrs. David L. Bensusan & Co., of 9, Finsbury Pavement, London, E.C· This hose is woven of the best flax, without seam, and is thus quite water-tight. It is only one-half the cost of rivetted leather piping and requires no attention whatever for preservation even in tropical climates. A further precaution against mildew, which might result from storing away wet in a wet place, is to have the hose prepared by Sir William Burnett's process, which is an absolute preservative to the canvas under any circumstances.

This hose has now stood the test of many years' service, having been introduced in the year 1839, and its lasting qualities and power of carrying any required pressure have been largely borne testimony to by many provincial fire brigades and other authorities.

As the Metropolitan Fire Brigade are now largely adopting a patent canvas hose instead of leather, it is probable that this latter will soon become a thing of the past, the general cheapness, durability, and portability of this canvas hose will obtain the notice it merits.

We note that one of the favourable testimonials is given by Mr. Downton, as to its efficiency and durability when applied to emigrant and other vessels. It may be supplied lined with india-rubber, but we understand that the good qualities of the hose are just as marked without that addition.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Snowdrop.—On the 23rd July a vessel intended for the North Sea fishing, named the *Snowdrop*, was launched at Messrs. Capps & Crip's yard, on the North Beach, Lowestoft, for Mr. T. E. Thirtle.

Cholmley.—On the 23rd July Messrs. Turnbull & Co., launched from their shipbuilding-yard at Whitby an iron screw steamer of the following dimensions:—Length, 240 ft.; breadth, 34 ft.; and depth, 17.9 ft. The vessel will be classed 100 A 1 at Lloyd's under special survey of hull and engines. Engines of 130-horse power by Richardson & Sons, Hartlepool. She has been built for Messrs. Turnbull, Sons & Co., Whitby, and is intended for the Black Sea trade. She is fitted with water ballast tanks, four powerful steam winches, patent windlass, and all the modern improvements necessary for a vessel of her size and class. She was named the *Cholmley*, by Mrs. Clayhills, of Larpool Hall.

Finsbury.—On the 24th July there was launched from the yard of Messrs. C. S. Swan & Hunter, Wallsend-on-Tyne, an iron screw steamer of the following dimensions:—Length, 270 ft.; breadth, 35 ft.; depth of hold, 24 ft. 6 in., with engines and boilers 32 and 26 in. cylinders and 42 in. stroke, by Messrs. Thomas Clark & Co. She has steam steering gear, iron decks, water ballast, and all the latest improvements, has been built to the order of Messrs. Watts, Ward & Co., and was named the *Finsbury* by Miss Lucy Grey.

Excellent.—On the 24th July Messrs. Short Brothers launched from their yard, at Pallion, Sunderland, an iron screw steamer, built to the order of Messrs. Anderson, Horan & Co., of this town. She is built on the two-decked principle with a long raised quarter-deck and full poop at after end for the accommodation of the captain and officers, and is handsomely fitted up in polished hardwood, bridge-house amidships over engines and boiler and topgallant forecastle fitted up for the accommodation of the crew. Her principal dimensions are:—Length between perpendiculars 240 ft.; breadth, 36 ft.; depth of hold, 18 ft. 6 in., with a dead weight carrying capacity of 2,300 tons. She has been built under Lloyd's special survey for the 100 A 1 class, and is fitted with water ballast in fore and after holds and under engines and boilers, divided into separate tanks for trimming purposes, four steam winches, steam steering gear, patent windlass, and all the latest improvements. As the vessel left the ways she was named the *Excellent* by Mrs. John Taylor, and was then taken to Mr. George Clark's Engine Works, where she will be fitted with compound surface condensing engines of 160-horse power.

ON the 24th July there was launched from the iron shipbuilding-yard of Mr. J. T. Eltringham, South Shields, a screw steamer of the following dimensions:—Length, 165 ft.; breadth, 25 ft.; and depth of hold, 13 ft. The engines of 65-horse power nominal, will be fitted on board by Mr. G. P. Rennoldson, South Shields. The steamer has been built to the order of Messrs. Humble & Thompson, of Newcastle, and will be employed in the general trade.

Mayo.—On the 24th July a paddle-wheel steamer named the *Mayo* was launched by Messrs. Laird Bros., Birkenhead Iron

Works, for the City of Dublin Steam Packet Company, to be employed in their cattle trade between Dublin and Liverpool. The new vessel is very similar to the last addition to the fleet of the Company—the *Cavan*, built also by Messrs. Laird Bros. The dimensions of the *Mayo* are:—Length, 262 ft.; beam, 27 ft.; depth, 15½ ft.; tonnage, 953 B.M. She is to be fitted with compound oscillating engines of 300-horse power, duplicates of those of the *Cavan*. The ceremony of christening the new vessel was performed by Miss Watson, daughter of Mr. William Watson general managing director of the City of Dublin Company, in Dublin.

Antisana.—On the 24th July a screw steamer, named the *Antisana*, was launched from the shipbuilding-yard of Messrs. R. & J. Evans & Co., Birkenhead. She is of 2,500 tons burthen, and 180 nominal horse power, for the firm of Messrs. George Bell & Co., of Liverpool. The vessel was christened by Miss G. Bell. She is intended for general trading purposes, and is fitted with all the latest improvements in both ship and machinery for ensuring the utmost economy in working. The vessel will be fitted with engines and boilers by Messrs. David Rollo & Sons, of Fulton Street, Liverpool.

City of Liverpool.—On the 24th July an iron-screw steamer was launched from the building-yard of Messrs. Richardson, Duck & Co., at South Stockton, of the following dimensions, viz.:—Length, over all, 350 ft.; length between perpendiculars, 340 ft.; breadth extreme, 40 ft.; depth, moulded, 29 ft. 10½ in.; tonnage, o.m., 2,689 tons; gross, n.m., 3,120 tons; dead weight carrying capacity, about 4,600 tons. She is classed 100 A 1 at Lloyd's as a three-decked ship, under special survey, being considerably stronger than required for classification. She has a double bottom all fore and aft, built on the cellular principle, two complete iron decks, a long bridgehouse amidships, and covered in forward and aft with a turtle back and hood of iron. She will be supplied with four double cylinder steam winches, Harfield's patent capstan windlass, and Bow & M'Lechlan's steam steering-gear in wheelhouse on bridge deck. The vessel will be rigged as a three-masted brigantine, and has been specially designed for the Atlantic trade and the carrying of cattle and grain cargoes, and fitted with double stanchions for shifting boards from top of double bottom to upper deck. Her engines, of 300-horse power, are supplied by Messrs. Blair & Co. (Limited), of Stockton, and are on the compound direct-acting principle, with cylinders 44 in. and 82 in. diameter, stroke 54 in., and a working pressure of steam of 80 lbs. This vessel is to the order of Messrs. W. H. Ross & Co., Liverpool. As the vessel was leaving the ways she was christened the *City of Liverpool* by Mrs. J. Richardson, of Potto Hall.

Irthington.—On July 26th Messrs. Osbourne, Graham & Co., Hylton, on the Wear, launched a screw steamer of about 3,000 tons deadweight. The steamer, which was named the *Irthington*, has been built under special contract, and is intended to be added to the fleet of Messrs. Wm. Milburn & Co. She will be fitted with powerful engines by Messrs. Black, Hawthorn & Co. The vessel is of particularly strong construction, with a special view to the American trade, being also fitted with steam steering gear, steam starting gear, steam windlasses, fresh-water condensers, and all other recent additions and improvements to hull and machinery.

Espiegle.—The *Espiegle*, six guns, composite sloop, was launched on the afternoon of August 4th at Devonport, Mrs. Curme, wife of Rear-Admiral Curme, performing the christening ceremony. The *Espiegle's* keel was laid on the 23rd September last. She is a vessel of 900-horse power, 170 ft. in length, 36 ft. in breadth, and of 1,124 tons displacement. She is a sister-ship to the *Phœnix* and *Miranda*, which were launched in September last year, and also to the *Mutine*, launched a fortnight ago. The *Espiegle* is built of steel, encased in wood, and only differs from the *Phœnix* and *Miranda* in the fact that their propellers cannot be hoisted on deck, as is the case with the *Espiegle* and the *Mutine*.

Earl of Rosebery.—On the 4th August an iron screw steamer, of about 1,200 tons, for Messrs. Martin & Marquand, of Cardiff, was launched by Messrs. Alex. Stephen & Sons, at Linthouse. This steamer has been built to class 100 A 1 at Lloyd's, under special survey. She has provision for water ballast on the bracket principle. Her engines are of the most improved construction, with cylinders 28 and 52 in. diameter, by 36 in. stroke, and a working pressure of 75 lbs. The vessel, which is intended for the iron ore and general trades, was named *Earl of Rosebery* by Mrs. Martin, wife of the managing owner, and is to be commanded by Captain C. Miller.

San Fernando.—On the 4th August an iron screw steamer named the *San Fernando*, built to the order of Messrs. Stephenson, Clarke & Co., of London, was launched from the shipbuilding-yard of Mr. Robert Thompson, jun., Southwick, Sunderland, her dimensions being as follows, viz.:—210 ft. long, by 29½ ft. broad, and 16 ft. 2 in. depth of hold, and has been built under Lloyd's special survey to class 90 A 1. Her engines, which are of 115-horse power, have been built by Mr. John Dickinson, Monkwearmouth, and are on the inverted direct-acting compound surface-condensing principle. The vessel has been constructed with a plate keel, having a long full poop aft. containing a saloon fitted up for first-class passengers, house aft for captain, and entrance to saloon; also all necessary accommodation amidships for engineers and officers, and a long, full forecastle for second-class passengers and crew; and is fitted throughout with all the latest improvements, including ample water ballast, two steam winces, steam crane, and donkey boiler, patent amidships steering apparatus, and patent screw gear aft, Harfield's patent windlass, &c.

George Stanton.—On August 7th the *George Stanton*, an iron twin-screw tugboat, built to the order of the Shropshire Union Railways and Canal Company by Messrs. Laird Bros. was launched from their works at Birkenhead. The ceremony of christening the steamer, which was named the *George Stanton*, was performed by Mrs. Bateson. It is intended to employ the new tug principally in connection with the company's traffic between Liverpool, Birkenhead, and Ellesmere Port. Her dimensions are:—Length, 100 ft.; beam, 21 ft.; depth, 8 ft.; and she is fitted with two sets of inverted compound engines to indicate about 300-horse power.

Dallam Tower.—On August 7th, Messrs. M. Pearce & Co. launched from their iron shipbuilding-yard at Stockton-on-Tees an iron screw steamer of the following dimensions:—Length between perpendiculars, 285 ft.; extreme breadth, 35 ft. 3 in.; depth from underside upper deck to top of floors, 24 ft. 6 in. This vessel is about 2,100 tons gross register, and will carry about 3,100 tons deadweight, at about 22 ft. draught of water. She bears the highest classification granted by Lloyd's, and has been built under special survey, of the three-decked rule, the main one being of iron. She is flush-decked, with bridge, chart, and wheel houses amidships. The cabin is situated aft under the poop deck, the topgallant forecastle, being fitted for crew, &c., and both are replete with accommodations for comfort and convenience. This vessel's engines, which are on the compound principle, are by Messrs. Blair & Co., of Stockton-on-Tees, and are of 150-horse power. She is fitted with Emerson, Walker & Co.'s patent combination capstan windlass, four double cylinder steam winches, double bottom for water ballast, and the appliances for ventilation and other sanitary purposes, as also for loading and discharging cargoes are of the most recent and improved description. She is built to the order of Messrs. Stumore, Weston & Co., of London and Liverpool, and received the name of *Dallam Tower* as she left the ways, the christening ceremony being performed by Mrs. Pilcher, of Liverpool.

Countess of Durham.—On the 7th August the first steam launch built of steel on the Wear was launched from the yard of Mr. Robert Collier, at Monkwearmouth. Her dimensions are:—Length, 40 ft.; breadth, 7 ft. 6 in.; depth of hold, 4 ft. 10 in. On leaving the ways she was christened the *Countess of Durham* by Miss Elizabeth Ann Bell, of Darlington. The launch was then towed down the river by the steamtug *Snowdrop*, and moored in the north dock to have her engines put in and otherwise fitted up.

Grimsel.—On August 7th there was launched from the iron shipbuilding yard of Messrs. John Redhead & Co., a steamer named the *Grimsel*. The vessel has been built to the order of Messrs. Cay, Hall & Co., South Shields, and is of the following dimensions, namely, length, 250 ft.; breadth, 34 ft.; depth of hold, 17 ft. 6 in., and 1,300 tons register. The engines and boilers have also been constructed by Messrs. Redhead & Co. The engines are on the compound surface-condensing principle, and are of 130-horse power nominal. The steamer has a long raised quarter deck, bridge and topgallant forecastle. She has complete iron decks fore and aft, the upper deck being sheathed with wood. She is also fitted with water ballast, three steam winches, Harfield's patent windlass, and all the latest improvements. The steamer will be classed 100 A 1 at Lloyd's. The ceremony of naming the vessel was performed by Mrs. S. S. Hall, of South Shields.

Sandal.—On the 7th August Messrs. Gray & Co. launched from their shipbuilding yard, at West Hartlepool, a screw steamer, built to the order of Messrs. J. Merryweather & Co., of West Hartlepool. Her dimensions are:—Length between perpendiculars, 256 ft. 6 in.; breadth, 34 ft. 6 in.; and depth of holds, 19 ft. 8 in. and 24 ft.; classed 100 A 1, the highest class at Lloyd's. As she left the ways she was christened the *Sandal*, after a village of that name in Yorkshire, by Mrs. Joseph Merryweather, of Seaton Carew.

Miss Williams.—On August 10th Messrs. Rees, Jones & Son, shipbuilders, launched from their building-yard at Port Dinorwic a schooner named the *Miss Williams.* Her dimensions are:—Length of keel, 73 ft.; length over all, 77 ft.; depth of hold, 9 ft. 9 in. She is owned by Captain Williams & Co.

Simoom.—On the 10th August there was launched from the building-yard of Messrs. C. Mitchell & Co., Low Walker, an iron screw steamer, named the *Simoom*, built by them to the order of the Bedouin Steam Navigation Company, Liverpool, the managers of which are Messrs. W. & R. Thomson. The *Simoom* is the fourth vessel recently constructed for the same owners. The present ship is 3,000 tons burthen; has full poop, topgallant forecastle, and is covered over amidships. She is built even beyond the requirements of Lloyd's highest class, and embraces all the latest improvements for efficient and economical works. On leaving the ways she was named the *Simoom*, by Miss Heslop, and immediately after the launch was taken to the shears of the Wallsend Slipway and Engineering Company, where she will be fitted by them with engines capable of indicating 900-horse power, similar to all the preceding vessels belonging to the Bedouin Company.

Cadoxton.—On August 10th a steamer with clipper stem was launched from the shipbuilding-yard of Messrs. Schlesinger, Davis, & Co., at Wallsend. This vessel which is a sister ship to the *Castleton*, launched a few months ago by the same firm, has been built to the order of Mr. Matthew Cope, of Cardiff, and co-owners, and is intended for the general carrying trade. Her leading dimensions are as follow:—Length, over all, 279 ft.; breadth, moulded, 33½ ft.; depth, 24 ft. 1 in., and she is built in the most substantial manner to take Lloyd's highest class. A patent windlass is fitted forward and worked by steam, and powerful steam winches are fitted to all the hatches. The cabin accommodation is aft, under a full poop, and consists of saloon, Captain's room, and state rooms for passengers, bath room, Steward's pantry, &c. The engines, which are being built by Messrs. R. & W. Hawthorn, of Newcastle, have cylinders 32 and 62 in. diameter, and a stroke to each of 40 in. As the vessel left the ways she was named the *Cadoxton* by Miss Browne, daughter of Mr. B. C. Browne, one of the partners of Messrs. R. & W. Hawthorn.

Assyrian Monarch.—On August 10th the *Assyrian Monarch* (s), which has been built by Earle's Shipbuilding Company to the order of the Royal Exchange Shipping Company, London, was launched from the builders' yard at Hull. She is the first of four steamers at present under contract for the above-named Shipping Company to trade in a regular line, to be named the "Monarch Line," between London and New York. The other three are in course of construction by Messrs. M'Millan & Son, Dumbarton, on the Clyde. The *Assyrian Monarch* is the largest vessel that has yet been built at Hull, her dimensions being as follows:—Length, 372 ft.; breadth, 43 ft.; depth, 36 ft. 6 in. Her displacement when loaded is 7,500 tons. Her engines are 2,500-horse power effective. She is built of steel made on the Siemens-Martin principle, and has a continuous double-bottom, extending fore and aft, on the principle adopted by the Admiralty. The pumping arrangements in connection with the double bottom are capable of discharging water at the rate of 100 tons per hour, and in case of necessity these pumps can be applied in addition to the other patent steam pumps on board. There are four decks, and seven iron water-tight bulkheads, arranged in accordance with the Admiralty requirements. Another important and novel improvement is the arrangement for carrying grain in bulk, by means of iron bins or compartments, thus anticipating the recommendations given in the recent report of the Royal Commissioners regarding the safety of grain-carrying vessels. A compartment has been especially fitted up between decks for carrying fresh meat, and a well-ventilated shelter deck has been constructed over the main deck for the safe and humane transport of cattle across the Atlantic. The engines have also been constructed by Earle's Company, the working parts being of unusual strength. The vessel is fitted with seven powerful steam winches, which will enable the cargo to be discharged or loaded in two or three days. The steam steering-gear is Muir & Caldwell's patent. The vessel is specially adapted for carrying emigrants and troops; she is four-masted, and the amount of canvas available is such, that in case of emergency she would be safely navigable by sail alone. It may be mentioned that the plans for construction of all four vessels have been approved by the Admiralty, and they are on the Admiralty list, available and suitable as cruisers and transports in case of war. The vessels will be classed at Lloyd's in the highest grade, and also in the Bureau Veritas. The ceremony of christening was performed by Lady Brown.

Limpopo.—On the 19th August there was launched from the yard of the Tyne Shipbuilding Company (Limited), Wellington Quay, an iron screw steamer, of the following dimensions, viz.:—Length, 248 ft.; breadth, 32 ft.; depth, top of keel, 19 ft. 9 in.; gross tonnage about 1,200; class 100 A 1. She has been built to the order of Mr. W. Gray, of Dawlish, on the bracket system, and is intended for a special trade. Her engines, which are to be supplied by Thomas Clark & Co., of Elswick, are of 120 h.p., with Mr. Gray's patent boilers. The steamer, on leaving the ways, was named the *Limpopo* by Mrs. W. Gray.

Khyber.—On the 21st August Messrs. W. H. Potter & Son launched from their shipbuilding works, Queen's Dock, Liverpool, a fine new iron sailing vessel of the following dimensions:—Extreme length, 293 ft.; beam, 39 ft. 9 in.; depth of hold, 24 ft. Tonnage: Nett register about 1,880 tons, B.M. 2,050, burthen 3,100. The launch was most successful, the vessel being named the *Khyber* as she left the ways. The vessel was launched by Mrs. Adams, and christened by Mrs. M'Kenzie. The *Khyber* has been built to the order of Messrs. T. & J. Brocklebank, of Liverpool. She is classed 100 A at Lloyd's, and 20 years in red in the Liverpool Underwriters' book, her scantling being considerably in excess of classification requirements, and her fittings of the most recent and approved designs. The *Khyber* is intended for the East Indian trade, and will be commanded by Captain M'Kenzie.

Craigmore.—On the 21st August the Barrow Shipbuilding Company launched from their yard a steamer of about 2,000 tons burthen, built by them to the order of Messrs. W. Johnston & Company, of Liverpool and Barrow, and intended for the Danube trade. She was named the *Craigmore* by Mrs. Frank Shleman, of Barrow. The new steamer is 260 ft. in length, 34 ft. in breadth, and 18 ft. depth of hold. Another of the same size and character is being built at Barrow for the same company.

The Cyanus.—Messrs. Edward Withy & Co., launched on the 21st August from Middleton Shipyard, West Hartlepool, a steel screw steamer built to the order of Mr. George Steel, for Messrs. Steel, Young & Co., of London and West Hartlepool. This vessel is No. 88 in the builder's yard, and is the fifteenth steamer built for the same owners. The steel of which she is built has been supplied by the Landore Siemens Steel Company, of Landore, near Swansea. Her principal dimensions are:—Length, B.P., 264 ft. 5 in.; beam extreme, 34 ft. 4 in.; depth, moulded, 19 ft. 6 in. She has a long full poop, and T.G. forecastle; has double-bottom all four and aft for water ballast, constructed on the longitudinal and bracket system. The main and poop decks are of steel, and the chart-house, engine skylight, cabin companion and skylight, as also the main rail, are built of iron instead, of as they usually are, wood. She has been built under Lloyd's special survey for the 100 A 1 class, and constant tests of the material used have been made at the builder's works, in accordance with the special regulations of Lloyd's Committee for steel vessels. The vessel will be fitted with engines of 150-horse power by Messrs. T. Richardson & Sons, of Hartlepool Iron Works. As the vessel left the ways she was christened, by Mrs. E. Light, of London, *Cyanus.*

The Hampshire.—Messrs. W. Doxford & Sons launched from their shipbuilding-yard at Pallion, Sunderland, on 21st August a large screw steamer named the *Hampshire.* Her length between perpendiculars is 316 ft., and her extreme breadth 38 ft., the depth moulded being 28 ft. She is built on the Webb frame principle, without hold beams. Her gross tonnage is 2,550, and her nett tonnage 1,660 tons. A cellular bottom has been made for water ballast, and has been fitted with all necessary steam winches, &c., together with the requisite appliances for loading and discharging. She will have Muir & Caldwell's steam steering apparatus. The engines will be fitted by the builders, the cylinders being 40 in. and 73 in., with a 48 in. stroke. The boiler pressure will be 80 lbs., it being intended to steam the vessel at a high rate of speed. She is intended for trading with general merchandise, and she will also have accommodation for first-class passengers. Her class will be 100 A 1 at Lloyd's. The vessel, which has been built for Messrs. Geo. Marshall & Sons, of London, received her name from Miss Cook, of Alnwick, who performed the usual christening ceremony. This is the second vessel launched by Messrs. Doxford during the past week.

Otway Tower.—Messrs. Wigham, Richardson & Co., launched from their yard at Low Walker-on-Tyne, on 21st August a screw steamer, named the *Otway Tower*, which vessel has been built to the order of Messrs. Stumore, Weston & Co., of London and Liverpool. The dimensions of the vessel are :—Length, 290 ft. ; breadth, 35 ft. ; depth, 25 ft. 6 in. moulded. Her engines are 1,300-horse power effective ; the boilers are of steel, and her average working speed when loaded is expected to be fully 10 knots. This is the second steamer built by Messrs. Richardson for the above-named firm, and they have another larger boat on the stocks. The vessel is supplied with steam steering-gear, and the engines with steam starting-gear. The water ballast is fitted in the double bottom, which is on the bracket system.

Bernard Hall.—The second vessel built by Mr. James Laing for the West Indian and Pacific Steamship Company was launched from his Deptford yard, Sunderland, on the 21st August. As the vessel left the ways she was named the *Bernard Hall* by the Mayoress of Liverpool. The new boat, when finished, will be a sister ship to the *Haytian*. The principal dimensions of the *Bernard Hall* are :—Length, 335 ft. ; breadth, 38 ft. ; and 26 ft. depth of hold. She has two iron decks, accommodation for 30 first-class passengers amidships, the forecastle for sailors and firemen being aft, and will be fitted with all the latest improvements in the way of steam winches, windlasses, steam steering gear, &c. The engines have been built by Messrs. George Forrester & Co., of Liverpool, and they will be put on board at the South Dock.

Ingerid.—On August 23rd Messrs. Raylton Dixon & Co. launched from their Cleveland Dockyard, Middlesbrough, an iron screw steamer, which has been built to the order of Messrs. D. Burger & Sons, of Rotterdam, for their line of steamers between that port and Berger, in Norway. The dimensions of this vessel are :—Length, 183 ft. ; beam, 24 ft. 6 in. ; and depth of hold, 14 ft. She will be fitted with a pair of 70-horse power compound engines by Messrs. Thomas Richardson & Sons, of Hartlepool. Being intended for the conveyance of passengers, she is built with long poop, which will contain handsome saloon and every accommodation required. On leaving the ways she was christened the *Ingerid* by Miss Mabel Cochrane Dixon, daughter of the builder. The *Ingerid* has been built under the supervision of Mr. J. de Hoog, of Amsterdam, who also superintended the Rotterdam Lloyd's large mail steamers, lately constructed by the same builders, and she will be commanded by Captain De Vries, of Rotterdam.

Ottawa.—Messrs. Chas. Connell & Co. launched from their yard on August 23rd an awning-decked iron screw steamer of 3,730 tons gross, which has been built with several extras beyond the requirements of the highest class at Lloyd's, to the order of Messrs. Flinn, Main & Montgomery, Liverpool, for the Mississippi and Dominion Steamship Company (Limited). As the ship left the ways she was named *Ottawa* by Mrs. John Thompson, and was immediately towed to the harbour to receive her machinery, which is being supplied by Messrs. Thomson, Finnieston Engine Works. The *Ottawa*, besides having ample accommodation for a few passengers, has been specially fitted up to carry a large number of cattle, and is the third vessel built by Messrs. Connell for this company.

LAUNCHES.—Scotch.

Konoowarra.—On July 23rd, there was launched from the shipbuilding-yard of Messrs. Russell & Co., Greenock, a screw-steamer built to the order of Messrs. Carson & M'Ilwraith, of Melbourne, which is intended for the Australian coasting trade. Her dimensions are :—Length, 246 ft. ; breadth, 33 ft. 6 in. ; depth, 16 ft. 6 in. ; with a burthen of 1,300 tons. As she left the ways she was named the *Konoowarra*. Her engines, which are to be of 150-horse power, will be supplied by Messrs. Kincaid, Donald & Co., Greenock. After the launch the new vessel was towed to the East India Harbour, where her engines will be put on board. The *Konoowarra* is a sister ship to the *Tamarung*, launched by the same builders some months ago.

Titania.—On the 24th July Messrs. David and William Henderson & Co., launched from their Meadowside Works at Partick an iron screw-steamer of 2,150 tons, and of the following dimensions : —Length 320 ft. ; breadth, 36 ft. 6 in. ; depth, 26 ft. hold. She has been built to the order of Messrs. Donaldson Brothers, 67, Great Clyde Street, and will form one of their Canadian and South American fleet of steamers. On leaving the ways the vessel was named *Titania* by Mrs. G. S. Rodger, Moray Bank, Langside. The *Titania* has been built under special survey, and will be furnished by the builders with compound machinery of 200-horse power. She is a sister ship to the *Cynthia*, recently furnished by the same builders.

Lady of the Isles.—On the 27th July Messrs. John Reid & Co. launched at Port Glasgow, a steam-yacht about 125 ft. in length, and 100 tons, for Lord Macdonald, of the Isles. This yacht has been named the *Lady of the Isles*, and is the second steam-yacht of the same name built for Lord Macdonald by this firm. The first was purchased some time ago by Lord Aberdour, and is now known as the *Queen of the Isles*. After being completely fitted out the yacht will proceed to his Lordship's shootings at Skye, and remain there for three months. Thereafter it is expected she will proceed to the Mediterranean, where her owner intends to spend the winter.

Gooddy.—On July 28th Messrs. H. M'Intyre & Co. launched from their shipbuilding-yard at Merksworth, Paisley, the *Gooddy*, an iron screw steamer of 300 tons, built to the order of Signor Eligio Giacopini, of Spezzia, Italy, for the marble trade. The ceremony of naming was performed by Miss Mary Thomson, of Paisley.

La Vallette.—On the 3rd August there was launched from the shipbuilding-yard of Messrs. Scott & Co., Cartsdyke, Greenock, a screw steamer which has been built to the order of the Campagnie Generale Transatlantique. The vessel is of the following dimensions :—Length, 185 ft. ; breadth, 25 ft. ; depth, 17 ft. 6 in. ; and 550 tons burthen ; and as she left the ways she was named *La Vallette*. After the launch she was towed round to the East India Harbour, where her machinery will be put on board. The *La Vallette* is the last of the three steamers which the Messrs. Scott contracted to build for the French company named.

Ferrara.—On the 4th August, there was launched from the building-yard of Messrs. Robert Steele & Co., Greenock, a screw steamer named the *Ferrara*. She is built entirely of steel, and is intended for the Baltic trade of the Leith, Hull, and Hamburg Shipping Company. The *Ferrara* has been built to the order of Messrs. James Currie & Co., Leith. She is 250 ft. in length, 33 ft. beam, and 17 ft. 3 in. depth of hold, and her gross tonnage is 1,130 tons. She will be supplied by the builders with a pair of compound direct-acting engines, with cylinders 30 and 52 with 36-in. stroke, and capable of indicating 550-horse power. The vessel is fitted with all the most modern improvements for the carrying of grain in bulk. The *Ferrara* is a sister vessel to the *Toledo*, which was launched a few months ago.

Auchintoul.—On the 4th August there was launched from the building-yard of Messrs. Hall, Russell & Co., Aberdeen, an iron screw steamer named *Auchintoul*, of the following dimensions :—Length, 270 ft. ; breadth, 34 ft. 6 in. ; depth, 24 ft. ; and 1,600 tons gross register. This vessel has been built under special survey to class 100 A 1 at Lloyd's, and will be fitted with compound surface condensing engines of 180-horse power nominal, steam winches, steam steering gear, patent windlass, water ballast, and all the most approved appliances for facilitating the loading and discharging of cargoes. The *Auchintoul* is owned by Messrs. Adam & Co., and is intended for the Mediterranean and Atlantic trades, under command of Captain Cook, late of the *Alva*. As the vessel was leaving the ways she was named the *Auchintoul* by Mrs. Thomas Adam, and was afterwards taken to the sheer poles for the purpose of receiving masts and machinery.

Kenmore.—On the 5th August there was launched from the Caledon Shipbuilding-yard, Dundee (Mr. W. B. Thompson's), an iron screw steamer. She is 760 tons register, and will be fitted with engines of 90-horse power. Her dimensions are :—Length, 202 ft. ; breadth, 27 ft. ; and depth, 14½ ft. All modern improvements will be introduced, and Mr. Thompson's patent steering gear will be applied. The christening ceremony was performed by Miss Henderson, daughter of Mr. William Henderson, merchant. The steamer, which was named the *Kenmore*, is built to the order of Mr. James Millar, shipowner, Dundee, and will be employed in the Archangel, Baltic, and Continental trades. She is to be commanded by Captain Sangster, late of the *Queen* (s).

Mandalay.—On August 6th Messrs. Russell & Co. launched from their Greenock yard an iron sailing barque, of 900 tons register, named the *Mandalay* by Miss Aitken, daughter of James Aitken, Esq., sugar refiner. The vessel has been built to Lloyd's highest class, of extra strength, and large carrying capacity, and is owned by Messrs. W. & J. Crawford. After being finished the *Mandalay* will go to Glasgow to load on Messrs. Aitken, Lilburn, & Co.'s Australian berth. She will be commanded by Captain Scott. The dimensions of the barque are as follow :—Length, 194 ft. ; breadth, 32 ft. 6 in. ; depth, 17 ft. 7 in. She will carry a dead weight cargo of 1,460 tons.

Star.—On August 9th a clipper-rigged schooner was launched from the shipbuilding-yard of Mr. James Petrie, Dundee. The vessel, which was named the *Star* by Miss Maria Petrie, is intended for the Baltic trade. She is 110 tons gross, 82 ft. long, 20 ft. broad, and 10 ft. 9 in. depth of hold.

Bhundara.—On August 9th Messrs. Wm. Denny & Bros. launched from their shipbuilding-yard at Dumbarton, a steel screw steamship of the following builders' dimensions, viz.:—Length, 300 ft.; breadth, 40 ft.; depth 26 ft. 6 in.; and about 2,880 tons gross register. She has been built to the order of the British India Steam Navigation Company (Limited), to class 100 A 1 at Lloyd's (special survey), and has also been surveyed and passed by the Admiralty as suitable for a first-class troop-carrying ship. This vessel, like a number of others constructed by this firm for the same company, has been built on the continuous double-bottom system. Her engines, which are compound direct-acting, will be supplied by Messrs. Denny & Co., engineers, Dumbarton. On leaving the ways she was named the *Bhundara* by Miss Macnaughton, daughter of Mr. P. Macnaughton, secretary to the company.

Otter.—On the 12 August Messrs. Blackwood & Gordon, shipbuilders and engineers, launched from their yard at Port Glasgow, an iron screw steamer of the following dimensions:—Length, 142 ft.; breadth of beam, 23 ft.; and depth of hold, 10 ft. 4 in.; the gross tonnage being 360. The engines, which are supplied by the builders, are compound surface-condensing, and are 45-horse power nominal. This steamer has been constructed for the Cunard Company (Limited), to be used as a tender. She has been named the *Otter.*

Hoihow.—On the 19th August, Messrs. Scott & Co., shipbuilders, launched from their shipbuilding-yard at Cartsdyke, Greenock, a screw steamer, named the *Hothow*, of the following dimensions:—Length, 250 ft.; breadth, 31 ft.; depth, 24 ft. 3 in.; and 1,400 tons burden. She has been built to the order of Messrs. John Swire & Sons, London, and will be engined by the builders. The boilers are fitted with Fox's patent corrugated furnaces, by the Leed's Forge Company. After the launch the new steamer was towed down to the East India Harbour, where she will have her machinery put on board, and made ready for sea. She is intended for the China coasting trade.

Alene.—On the 21st of August there was launched from the building yard of Messrs. Aitken & Mansell, Whiteinch, a handsome screw steamer of over 2,000 tons gross register. This steamer is being constructed for the Atlas Steamship Company, of Liverpool, to the order of Messrs. Leech, Harrison, & Forwood, the managing owners. The vessel was named, on leaving the ways, the *Alene* (the name of the highest peak of the Rocky Mountains) by Mrs. Arthur B. Forwood, of Liverpool. The *Alene* will, when completed, take her place on the Atlas Company's mail line between New York, Jamaica, and Colon. Her dimensions are:—290 ft. long by 36 ft. beam, and 23 ft. 6 in. deep to the main deck. The accommodation for about 60 passengers is all placed in houses above deck. Messrs. John and James Thomson are constructing the engines of 300-horse power on the compound principle.

LAUNCH.—IRISH.

Ethel.—The first vessel built at the new shipbuilding yard of Messrs. Workman, Clark & Co., adjoining the Spenser Basin, Belfast, was launched on August 20th, the ceremony of christening being performed by Miss Young, daughter of Mr. John Young, D.L., Galgorm Castle, who named the vessel the *Ethel.* The *Ethel* is a steamer of 150 ft. in length; breadth (moulded), 21 ft. 6 in.; depth of hold, 10 ft. 9 in.; her tonnage being 370 tons gross. She has been built for Messrs. M‘Mullan & Gault, Ballymena, and will be engaged in the coasting trade. Her cylinders are 19 and 38 inches diameter, 30 in. stroke, with an indicating horse power of 400. They are on the compound direct-acting principle, with surface condensers, and were designed by the makers (Messrs. John Rowan & Sons, York-street Foundry) with all the most modern improvements, and with a view to economy.

TRIAL TRIPS.

Osmanli.—On the 30th July the Moss Steam Shipping Company's new steamer *Osmanli* took her trial trip off the Tyne. The vessel has been built by Messrs. C. Mitchell & Co., Low Walker. Her dimensions are:—Length, 330 ft.; breadth, 35 ft.; depth, 26 ft.; and tonnage, 3,300 ft. This vessel is equipped with the most modern machinery and appliances. The engines, 220-horse power nominal, are by Messrs. R. & W. Hawthorn, Newcastle, fitted with F. C. Marshall's patent slide valve gear. The engines indicated during four runs over the measured mile an average of 1,420-horse power, and the mean speed of the vessel was 11·6 knots per hour, the draught of water being 18 ft.

Kaiser.—On the 31st July the new steamer *Kaiser* recently launched from the yard of Messrs. W. Gray & Co., for the West Hartlepool Steam Navigation Company proceeded on her trial. Under the command of Captain Bulman, and having a numerous company on board, the vessel steamed as far as Whitby, averaging 11 knots per hour, with a cargo of 900 tons on board. The dimensions of the *Kaiser* are:--Length between perpendiculars, 220 ft.; breadth, 28 ft. 6 in.; depth, 16 ft. and 23 ft. The *Kaiser* is classed the highest class at Lloyd's, and was built under the special survey of Captain G. Wright. The engines of 130-horse power, are by Messrs. T. Richardson & Sons, of Hartlepool, who have applied to them their steam-starting gear, by which momentary control can be held over the vessel. The *Kaiser* is licensed to carry 350 passengers, and trade between West Hartlepool and Hamburg.

Adria.—The new steel screw steamer *Adria*, built and engined by Messrs. Blackwood & Gordon for the Adria Steamship Company, of which Messrs. Burrell & Son, Glasgow, are the managing owners, at a trial trip of her speed on the 31st July, ran the measured distance at the rate of 13 miles per hour. The *Adria* has been specially built for the Hungarian flour trade, and will load at Glasgow for Venice, Trieste, and Fiume.

Envoy.—On the 5th August there proceeded to sea from the shipyard of Messrs. Raylton Dixon & Co., at Middlesbrough, the screw steamer *Envoy*, which has been built to the order of Messrs. E. Harris & Co., of this town. She is 188 ft. long, and 30 ft. 3 in. in breadth, and 13 ft. 11 in. in depth of hold, and will carry 960 tons on a draught of 14 ft. She is built on raised quarter deck principle, and has water ballast in after hold and under engine-room; has two steam winches and every convenience for the rapid loading and discharging of cargo. Her engines are 75-horse power, by Messrs. Blair & Co. (Limited), of Stockton. A large party of her owners and friends assembled on board, and then proceeded to sea, when a very satisfactory run was made, after which she returned to Middlesbrough.

The Kingfisher, 6, composite screw sloop, 1,124 tons, 900-horse power, which was recently built at Sheerness, went for a preliminary trial of her engines and machinery over the measured mile at the Maplin Sands on the morning of August 5th. The ship was in charge of a staff of the Medway Steam Reserve officials, and everything was found to answer very satisfactorily.

Ranger.—The *Ranger*, 3, screw composite gun vessel, 774 tons, 750-horse power, which was lately brought to Sheerness from Glasgow, where she was built by Messrs. J. Elder & Co., to be brought forward for sea, went for a six hours' run on August 5th over the measured mile at the Maplin Sands. The engines and machinery were found to answer satisfactorily in every particular. The ship was in charge of a navigating party from the Medway Steam Reserve at Chatham.

Albert Victor.—A special trial trip of the *Albert Victor* was made on Saturday, August 7th, between Folkestone and Boulogne. The vessel is one of three which the South-Eastern Railway Company have had built, with the main object of accelerating the passage between the two points mentioned. The boats are a great improvement on those which have been performing the service, and the accommodation is considerably greater. The *Albert Victor*, under the charge of Captain Dane, performed the trip between pier and pier in one hour 29½ minutes, against tide and wind, and a practical illustration of the improvement effected was the arrival subsequently at Boulogne of the ordinary tidal boat, which had taken 40 minutes longer to accomplish the passage. Luncheon was served at the Buffet Gare Maritime, the Hon. James Byng, as director of the South-Eastern Railway Company, presiding, supported by Messrs. J. Whatman, and A. M. Watkin, directors, Mr. Myles Fenton, general manager, Mr. John Shaw, secretary, Mr. C. Sheath, and other officials of the company, Mr. O. L. Stephens, director of the London and North-Western Railway Company, M. Tiret, Dr. Levois, M. Caville, Sir Henry Hunt, Mr. Norwood, M.P., &c. The toast of "The President of the Republic" was replied to by M. Grenier, *sous préfet*, who spoke of the enormous advantages which France and England derived from each other by the increased facilities of communication between them. He proposed the next toast, "The Queen of England and the Royal Family," which was cordially received. In proposing the toast of the day, "Success to the *Albert*

Victor," the chairman expressed his great regret at the unavoidable absence of Sir Edward Watkin, M.P., the chairman of the company, whom he regarded as the most able administrator of railways in England. Thirty-three years ago, when he (Mr. Byng) became a director of the company, the boats performing the passage were very small indeed and did not belong to the company; but when they found that the increased requirements of the service demanded it, they decided on having a superior class of boats, and Messrs. Samuda built for them the *Victoria*, the *Albert Edward*, and the *Alexandra*, which had been very successful. To meet the demand, however, for still more rapid communication they had resolved on building altogether superior and larger boats in anticipation of the improvement of the harbours on both sides of the Channel. It was the great desire of Sir Edward Watkin that the communication between the two countries should be made with the greatest possible facility, and he felt that nothing would more conduce to the interests of both nations. Mr. Samuda, whose name was coupled with the toast, in reply alluded to the long connection of Mr. Penn (in the construction of the engines of the boats) and himself with the company. He believed the *Albert Victor* would be as great an advance as were the *Victoria*, the *Albert Edward*, and the *Alexandra* over the original boats, and expressed a hope that the friendship subsisting between France and England would before long be extended to the whole of Europe. The South-Eastern Railway Company had established a claim on the gratitude of the people of both nations by meeting the growing and ever-increasing requirements for improved communication between them. He believed he was correct in stating that the *Albert Victor* was the fastest Channel steamer afloat, and concluded by proposing "Success to the South-Eastern Railway Company." The chairman replied, and expressed a hope that they would soon be able to put on the other two boats *Louise Dagmar* and the *Duchess of Edinburgh*. Mr. John Penn gave "The Chamber of Commerce of Boulogne," to which Mr. Gosselin replied. The chairman next proposed "The Officers of the South-Eastern Railway Company," and alluded to Mr. Shaw's long connection and eminent services to the company. His work had at length become almost too much for him, and Mr. Myles Fenton now assisted him. Mr. Fenton assured the chairman that the officers would do their utmost to perfect the communication between France and England, and observed that in all circumstances they hoped to make the service between Folkestone and Boulogne as comfortable as they could. Mr. Shaw, for whom there were loud calls, referred to the very great interest he had always taken in the service between Folkestone and Boulogne. They had performed the journey between London and Folkestone that day in an hour and a half, between Folkestone and Boulogne in the same time, and, allowing four hours for the journey between Boulogne and Paris, they would be able to accomplish the great object of Sir Edward Watkin—to perform the service between London and Paris in little more than seven hours. He was sure the Northern of France Railway Company would render them every assistance. "The Shareholders of the South-Eastern Railway Company" was next given by the company's director in France, M. Achille Adam, who regretted the absence of his uncle, M. Alexandre Adam, of the Northern of France Railway Company. Mr. George Smith replied. The chairman next gave "The Northern of France Railway Directors," for which M. Lecœur responded. The return journey was shortly afterwards made, and the time occupied between Boulogne and Folkestone was one hour and twenty-five minutes, which it is hoped will be reduced by ten minutes.

Alexandre Bixio.—On the 9th of August the iron screw steamer *Alexandre Bixio*, of Havre, just completed by Messrs. M. Pearse & Co. at their shipbuilding-yard at Stockton, had her trial trip prior to being handed over to her Owners, the French Transatlantic Company. This vessel, like the two preceding her that have been built by Messrs. Pearse & Co. for the same firm, is 300 ft. long, against 36 ft. beam and 25 ft. 6 in. depth. She is a three-masted schooner-rigged vessel of 2,277 tons gross register, with a carrying capacity of 3,300 tons. Her class is 100 A at Lloyd's. In addition to the ordinary accommodation for officers and crew, the steamer is fitted for 12 first-class passengers. The vessel's engines are by Messrs. Blair & Co., of Stockton, being 180-horse power nominal, and on the compound surface-condensing principle. The steamer proceeded down the Tees into the bay where her compasses were adjusted, and all made ready for a trial of speed and capabilities. In the course of the morning a party of ladies and gentlemen marked on board from a tug, the steamer's head was then turned towards the south, and a run made as far as Whitby. The sea was quite smooth and the weather fine. In the run the vessel steamed a trifle over 11 knots, and proved fully satisfactory to all parties. At the conclusion of the voyage the *Alexandre Bixio* was moored in Middlesbrough Dock, where she will coal and proceed to her destination.

Warkworth Harbour.—On August 11 this screw steamer, built by Messrs. M'Intyre & Co., Paisley for Mr. Andrews, of Warkworth Harbour, went on her trial trip, and, after adjusting compasses, ran the measured mile, attaining a speed of nearly 10 knots, which was very satisfactory. This vessel is fitted with a pair of engines 85-horse power, having all the modern improvements to stand the high working pressure of 100 lbs. per square inch. The machinery was supplied by Messrs. Dunsmuir & Jackson, engineers and boilermakers, Govan.

Pearl.—On August 12 this new iron screw steamer, 150 ft. by 21 ft. 6 in. by 12 ft., built by Messrs. William Hamilton & Co., Port Glasgow, for Messrs. James Hay & Sons, Glasgow, left the former port on her trial trip. After adjusting compasses a run was made down the Frith, and a few turns over the measured mile was made with good results. A speed of 11 knots per hour was attained under easy pressure, and it is expected that this speed will be fully maintained when loaded, as she was rather light on her trial. The engines are a pair of compound surface-condensing of 70-horse power supplied by Messrs. Fleming & Ferguson, of Paisley.

Triumph.—The trial trip of this vessel, the largest ever built in the port of Middlesbrough, took place on the 12th of August, when she proceeded from the yard of her builders, Messrs. Raylton Dixon & Co., and, after a four hours' run northward and back, entered the Tyne, the port of her registry, to be delivered to her owners, Messrs. M'Intyre Brothers, who are successors to the firm of Hutchinson and M'Intyre, to whose orders she has been built. Her dimensions are—352 ft. length over all, 37 ft. 4 in. breadth of beam, and 27 ft. depth of hold; her gross register is 2,750 tons and carrying capacity about 4,000 tons. She has two iron decks laid, the upper one being covered with wood, which is flush from end to end, having open rail bulwarks, with long iron "whale back" or open forecastle, and a rounded hood or short open poop aft. Her engines, of 300-horse nominal, are by Messrs. Blair & Co., of Stockton, having cylinders of 43 by 80 in. diameter by 54 in. stroke, two boilers working at a pressure of 80 lbs., and will work up to 1,500 indicated horse-power. On her run round to the Tyne she easily accomplished over 12 knots, which was considered a very satisfactory result.

Antisana.—On August 19 the new steamship *Antisana*, belonging to Messrs. G. Bell & Company, was run out from the Mersey on her trial trip. Various experiments were tried with the engines working at different grades of expansion, and the steam reversing gear was tested with a most satisfactory result, a speed of from 10 to 11 knots being made. Messrs. David Rollo & Sons, of the Fulton Engineering Works, it will be remembered, erected the engines in this ship in three days and a half. Among the engine-room equipments are one of Hocking's condensers for supplying fresh water, in the event of the boat carrying either cattle or coolies, which will condense upwards of 1,000 gallons in 24 hours, one of Cochran's improved donkey boilers, and Durham's patent marine engine velometers. The vessel was built by Messrs. R. and J. Evans & Company, and is of the full poop and forecastle type, being covered in about 60 ft. amidships. Her dimensions are:—Length, 267 ft.; beam, 34 ft.; depth of hold, 23 ft. 9 in.; with a gross tonnage of 1,704 tons. She is fitted with all the modern appliances, and has a cellular or bracket bottom, carrying 300 tons of water ballast. The ballast is discharged, and the tank and holders cleared by a pulsometer, which has only recently been introduced for this purpose. This ship was under the command of Captain Millard, and the trial was pronounced to be thoroughly satisfactory.

Jan Breydel.—The s.s. *Jan Breydel*, of 4,000 tons burthen and 300 nominal horse-power built by Messrs C. Mitchell and Co. for Messrs Engels, Antwerp and New York Line, made a satisfactory trial of her machinery at the measured mile attaining on a mean draught of 19 ft. 3 in., an average of 12·4 knots. The vessel has been completed under the supervision of Captain Condere and Mr. Schaeffer, and embraces several of the most approved specialities for promoting safety, speed, and economy, viz., Emerson, Walker & Co.'s patent horizontal direct steam windlass, McLachlan's steam steering gear, Durham's Governor, Norton's unchokeable bilge suction boxes, Smith's pulsometer, and other modern improvements. There were present during the trial, Mr. Engels, the owner; Mr. Cinitchall, Messrs. W. Clark, Elswick Engine Works, Wm. Dobson, Schaeffer, Condere, Norton, Richardson, and other gentlemen representing various firms in the district. This fine vessel has been built and fitted out with a view to meet the special requirements of the service for which she is intended, and is commanded by Captain Nichol. At the conclusion of the trial the vessel proceeded for New York.

THE BOAT VOYAGE ACROSS THE ATLANTIC.

THE *Little Western*, in which two young American seamen, named G. P. Thomas and Frederick Norman, have just completed a risky passage across the Atlantic in what is known in New England as a "dory"—a handy, seaworthy boat, flat bottomed, with good sheer and broad in the beam, used by the cod fishermen on the Grand Banks. Used for this purpose, the "dories" are open boats, in which half a dozen men can ply their lines at the same time, capturing huge cod often as rapidly as they can haul them in. To fit one of these boats for the perilous task of crossing the ocean a deck becomes indispensable, and the *Little Western* has been so fitted all over, with the exception of a small cockpit abaft, in which the "watch on deck" during the six hours' vigils of the passage has steered the little craft and manœuvred the sails while the "watch below" was resting. The *Little Western* is 16 ft. 7 in. long over all, 6 ft. 7 in. wide, 2 ft. 6 in. deep, with raking stem and stern, sharp at both ends, her flat bottom being 13 ft. 6 in. long, and 3 ft. wide amidships, tapering to a point forward, and not being more than 8 in. broad aft. She is clinker built, of half-inch plank, the four lower streaks being cedar, and the three upper ones pine. There is one sleeping berth in the "cabin," and over it the "binnacle," visible to the helmsman through a narrow slit. She is cutter-rigged, her jib set flying from the cockpit to a short bowsprit, and she hoists a squaresail 8 ft. by 9 ft. with a 10 ft. hoist. The mast is 15 ft. high, the main sail 13 ft., the gaff being 6 ft., and the boom 14 ft. Being flat-bottomed and "beamy," these boats are fast with the wind free, and to make the *Little Western* weatherly a centreboard, dropping two feet is fitted amidships. All her running gear is fitted to lead to the cockpit, as her deck is not in a very safe place, especially with a fresh breeze and lying four points from the wind. Her *drague* for heaving-to is a stout piece of plank, 30 in. by 18, with combing round it like the lid of a box, weighted along one of the long sides to make it float upright like a log-ship, and toggled at the four corners to a double spar, to which the riding line is made fast. She has not been made a lifeboat, as she might easily have been by air-tight casing; and, as a consequence, her "Crew" have been twice within an ace of going down, and in bad weather incessant baling was needed to keep her afloat. She left Gloucester (Mass.), which is about 30 miles N.E. of Boston, on the 12th of June, carrying 500 lbs. of general ballast, 50 gallons of fresh water, 100 lbs. of bread, 50 lbs of tinned beef and tongue, 48 tins of canned fruit, 12 tins of condensed coffee, some chocolate, milk, corn, meal, oatmeal, dried fruit, and a few nick-nacks pressed on them by their sympathizing friends as they were leaving, but with no strong drink except a few bottles of port wine as a medicine. They had a serviceable kerosine cooking lamp with supply of the liquid fuel, and half a gallon of strong alcohol for the same culinary purpose when the weather was too bad to enable them to get at their can of kerosine. They had hot coffee twice a day, and though wet through with little intermission from the time of starting to their arrival in the Channel, managed to keep well and hearty. They were unfortunate in their weather, for the passage was made against a succession of strong easterly winds, high seas, and what American sailors call "fall" weather, instead of the pleasant time that it was fair to expect in mid-summer. They encountered a strong gale on the 21st of June in lat. 42 30 N., long. 60 W., had to heave to, and were blown back 70 miles, riding to their drague in 12 hours. Two seas were shipped during this anxious time, and baling was the orderof the day. The best day's work was performed when in mid-ocean, a slant of wind enabling them to log 160 miles as the day's run. On this day the *Little Western* bowled off nine knots an hour for several hours in succession, showing that, if she had been favoured with westerly winds, she could have made a good passage. As it was, she was 43 days from Gloucester to Scilly, a distance of about 2,700 miles. This gives a daily average distance made good of nearly 63 miles, which for so small a boat against high winds and head seas is a very creditable performance. The men had a sextant, but no chronometer, and the wet soon stopped the only watch they had. They navigated, therefore, by dead reckoning, checked by meridian altitudes of the sun; and, considering their difficulties, made a wonderfully good landfall, a lift in the haze about 6 p.m. on July 28th, showing them the Bishop's Rock lighthouse, just when, by calculation, they should have been within sight of the islands. Thence they had a pleasant run of two days to Cowes, where they anchored. After rest and refreshment they run up Channel, and through the Downs to London. They propose eventually to visit Antwerp, Brussels, Rotterdam, Amsterdam, Hamburgh, and St. Petersburg, sailing her to the different ports, and returning home by steamer from the Russian capital.—*Shipping and Mercantile Gazette.*

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

To the Editor of the MARINE ENGINEER.

SIR,—We have long wanted an organ such as the MARINE ENGINEER to ventilate our opinion. I hope your journal will become what it professes to be, a medium where Marine Engineers can express their opinions, and make suggestions, &c., which will benefit those desirous of advancing in their profession. As it is almost impossible for sea-going engineers to keep up a regular correspondence, seeing they are only a short time in port, yet, I believe there can be a great deal of information got from engineers making practical suggestions from what has come under their own observation, say, about the best means to prevent pitting in new boilers, priming and the management of engines at sea, and last, though not least, the most expeditious way to repair a serious breakdown at sea. Among your numerous sea-going readers there must be some of them that have had exceptional experience on the above heads, that I am sure the information would be eagerly welcomed by those having the management of engines. I should also like to know why there has been no recognition by the Board of Trade to engineers for special services rendered at sea. We frequently hear that Captain X by his admirable conduct or the skilful manner in which he effected certain repairs, was enabled to bring the ship safely into port, but you rarely hear any mention of the engineers, perhaps battened down for days, and their food supplied to them through the ventilators; probably after being exhausted with keeping the water down, relighting fires that have been washed out, they perish miserably like rats in a hole; this is no fancy sketch, as many of your readers experience it every winter, especially in the Atlantic. Surely the time has come when engineers may claim a standing in the merchant Navy of Great Britain. They are required to pass an examination as difficult as that of master, and I think it is time we were recognized by the Board of Trade as deserving some mark of their approval when there are exceptional services rendered. Trusting this may be the means of eleciting some opinion on the subject.

I am yours truly,

Genoa, *August 13th*, 1880. J. M.

To the Editor of the MARINE ENGINEER.

SIR,—I have read with much pleasure the accounts of "Break downs while at sea," and the remedies given by your several correspondents, and I have now much pleasure, if you think it worth publishing, to add another to the list, not that it will, perhaps, interest *deep sea* marine engineers, but another class of what I will call *inland rivers* marine engineers, among which you have many subscribers in India, China, and South America, and who, like myself, look eagerly forward to the monthly mail that brings us our journal. The engines I have the pleasure to have charge of are double diagonal, oscillating, compound, paddle engines of 360 nominal horse power, and about 1,000 indicated horse power.

While running full speed between K—— and B——, our port paddle wheel struck a sunken boat or snag carrying away completely the star bracket and breaking the star eccentric in several pieces. Being in an inland river and hundreds of miles from a station where there was a workshop, I was placed in the same circumstances as if I had been at sea, with the exception of the weather. I at once disconnected all the radius rods, and then made long hook bolts to hook on the arms and go through the floats, and then drew back the floats on wood chokes resting on the edges of the arms, of course making the chokes so that the floats would have the best effect on the water. I put four hook bolts to each float, and afterwards strengthened them further by putting long hook bolts from the horizontal stays through the outer edge of the floats and also lashed the float cranks with wire to the arms and outer and inner rings. The whole repairs were done in five hours, and we proceeded full speed after that detention with both wheels (the other engines were working while the work was being done) with very little difference in speed, and although working for three weeks after, before we arrived at Calcutta, yet only two bolts gave way, and that was with defective welding, as we had to weld nearly a third part, not having enough rod iron on board to make them all. I have heard of other makeshifts, such as cutting up the float and making them Venetian common floats, but it entirely spoils the floats, whereas this other way the floats only require a few wood plugs after the new star bracket and eccentric is fitted.

Yours, &c.,

Calcutta, *August, 2nd*, 1880. A YOUNG CHIEF.

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Morris, William	2 C	London.
Kirkaldy, John ...	2 C	do.
Swinburne, J. S.	2 C	do.
Grant, James F.	2 C	do.
Morris, Joseph ...	1 C	do.
Ley, Andrew F.	2 C	Bristol.
James, Robert ...	1 C	do.
Davies, Wm. H.	2 C	N Shlds.
Charlton, E. A.	2 C	do.
Carrick, Saml. S.	1 C	Shmptn.
Watson, Adam	1 C	Hull.
Loftus, Chas. F.	1 C	do.
Allan, George ...	2 C	Aberdn.
Boag, Walter ...	2 C	N Shlds.
Milne, William A.	2 C	do.
Longbottom, F.T.	2 C	do.
Harman, Wm. J.	2 C	do.
Dixon, Elias S.	1 C	do.
Neilson, John ...	2 C	London.
M'Farlane, James	2 C	do.
Drakard, John ...	2 C	do.
Bond, James L.	1 C	do.
Jones, Charles ...	1 C	do.
Waight, H. R. ...	1 C	Lvrpool.
Logan, George ...	1 C	do.
Cundle, Robert ...	1 C	do.
Owler, William	2 C	Glasgw.
M'Lean, George	2 C	Bristol.
Davenport, Henry	2 C	do.
Thomas, A. ...	2 C	do.
Hill, John ...	1 C	NShlds.
Jones, Owen ...	2 C	Lvrpl.
O'Brien, Benj. ...	2 C	do.
Lloyd, David L.	2 C	do.
Gibson, John ...	2 C	Hull.
Dick, William ...	2 C	N Shlds.
Wilson, H. D. ...	2 C	do.
Fox, Eugene C.	2 C	do.
Oliver, Henry ...	1 C	do.
Smith, William	1 C	do.
Danskin, John ...	2 C	Leith.
Westwood, George	2 C	do.
Gray, James ...	2 C	do.
Beaton, Angus ...	2 C	do.
Boucher, Chas. P.	2 C	Lvrpl.
Throssell, Edward	2 C	do.
Wade, John ...	2 C	do.
Edwards, Alexr.	2 C	do.
Edwards, W. D.	2 C	do.
M'Murray, James	1 C	do.
Jobson, William	1 C	do.
Philp, John ...	1 C	do.
Park, Chas. John	2 C	NShlds.
Rymer, James ...	2 C	do.
Coats, George D.	2 C	do.
Henderson, Wm.	2 C	do.
Wylie, William	2 C	do.
Mitchelson, T. ...	1 C	N Shlds.
Birtley, J. G. ...	2 C	do.
Halladay, W. H.	1 C	do.
Findlay, James ...	2 C	Lvrpool.
Moger, C. H. ...	2 C	do.
Macnaught, G. ...	2 C	do.
Brown, John ...	2 C	do.
Murray, W. G. D.	2 C	Dundee.
Anderson, James	2 C	do.
Gibson, James ...	2 C	do.
Bell, James ...	2 C	Glsgow.
Robertson, James	1 C	do.
Douglas, John C.	1 C	do.
Burt, Robert ...	1 C	do.
Coulson, Cuth. ...	2 C	Sndrlnd.
M'Kechnie, D.	2 C	Glasgw.
Moody, Andrew	2 C	Sndrlnd.
Young, Fredk. ...	2 C	do.
Lilley, Edward ...	2 C	do.
Cairns, John S. ...	2 C	do.
Fenwick, Geo. E.	1 C	do.
Johnson, Andw. T.	1 C	do.
Morton, Robert	2 C	London.
Blair, James C.	2 C	do.
Armstrong, John	2 C	do.
Hurley, Edm. M.	2 C	do.
Creighton, Joseph	2 C	do.
Wildey, Thomas	2 C	do.
Allan, John ...	2 C	do.
Spiers, Henry J.	2 C	do.
Highet, Robert	2 C	do.
Harris, Reuben J.	2 C	do.
Campbell, Robert	2 C	do.
Mackay, James ...	2 C	Bristol.
Paterson, James	1 C	Leith.
Williams, Joseph	2 C	Lvrpool.
Maxton, James ...	2 C	do.
Orr, William ...	2 C	do.
Andrew, Robert	1 C	do.
Daniel, G. M. P.	1 C	Plymth.
Colpitt, C. ...	2 C	London.
Elliott, Arthur ...	2 C	do.
Moss, Thomas ...	2 C	do.
Grey, William ...	1 C	NShlds.
Ferguson, W. S.	1 C	do.
Toward, Henry T.	1 C	do.
Brandon, Harry	1 C	do.
Coats, James ...	2 C	Grnock.
Nicol, Archibald	2 C	do.
Boyd, Andrew H.	1 C	do.
Whyte, James ...	1 C	do.
Marish, William	2 C	Bristol.
Good, Farrant ...	2 C	do.
Gibson, Robert	2 C	London.
Seaton, Wm. T.	2 C	Hull.
Ogden, Lewis ...	1 C	do.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

THE Clyde Light Trustees have adopted Pintsch's system of lighting all the buoys of the Clyde by means of compressed gas.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanica Appliances for use in Ships, from 23rd July to 19th August, 1880.

3034 J. Russell. Floating dock and lift.
3037 W. Keable. Steam boilers.
3040 E. W. West. Salt water condensers.
3041 C. G. Gumpel. Producing and directing electric currents, and applying to steering of vessels.
3045 F. J. Lemouche. Variable expansion valve.
3066 G. H. Babcock and others. Steam engines and boilers.
3070 H. Davey. Differential valve gear.
3085 P. M. Justice (communicated by C. G. Lundborg). Hulls of ships.
3089 J. and G. Day. Water elevators.
3092 F. N. and E. G. Baird. Anti-fouling composition for ships' bottoms.
3097 W. Seymour. Composition for cleansing boilers, condensers, &c.
3111 J. Donovan. Supporting, raising, lowering and disengaging ships' boats.
3146 H. E. Newton (communicated by A. L. G. Dehne). Pumps.
3147 S. P. Wilding (communicated by P. Carrera). Hand power motor, applicable to boat propulsion.
3163 C. F. Osborne. Propelling, steering, and manœuvering steam ships, &c., and apparatus therefore.
3165 P. Jensen (communicated by J. Comperghi). Propeller pumps.
3173 T. J. Stevens. Fittings employed in vessels for carrying cargo in bulk.
3177 N. Jarvie and W. Miller. Apparatus for extinguishing fire.
3184 J. A. and J. Hopkinson. Flue or tube for steam boilers.
3189 J. Robertson. Screw propellers.
3191 W. Palliser. Projectiles and firing apparatus for ordnance.
3202 W. Chadburn. Governors and governing valves.
3212 A. M. Clark (communicated by J. E. Culver). Steam generators, furnaces, and rotary engines.
3250 D. H. Brandon (communicated by B. B. Hotchkiss). Torpedo boats.
3256 J. A. and J. Hopkinson. Steam boiler and plate.
3258 J. A. and J. Hopkinson. Steam boiler tubes or ring plates for flues, and flues constructed entirely or partly thereof.
3268 W. Hanson. Apparatus for purifying feed water of steam boilers.
3287 S. Watkins. Blow-off apparatus for boilers.
3302 H. W. Cook. Construction of vessels, and propulsion of same.
3317 H. Ashton. Steam governors.
3333 T. E. Norton. Anchors.
3339 J. Wetter (communicated by L. C. Cheneval and others). Construction of grain-carrying ships.
3343 G. D. Robertson. Jet apparatus for ejecting solids, semi-liquids and gases.
3350 W. M. Brown (communicated by M. F. Davis). Propelling and steering row boats.
3357 W. R. Lake (communicated by J. B. Sheppard). Regulating speed of steam or other engines.
3369 C. S. de Bay. Driving propellers made up of two screws on concentric shafting, so as to allow of different pitches being used in those two screws.
3378 W. Clark (communicated by A. Figge and Count S. J. Ostrorgog). Propelling vessels.

Notes and Novelties.

PROPOSED NEW DOCK AT LIVERPOOL.—At the meeting of the Mersey Docks and Harbour Board on August 12th the Works Committee recommended that the northernmost section of the works sanctioned by the Act of 1873 should be proceeded with. It is proposed to construct a new dock immediately to the northward of the new steam dock at the north end, between the river and the goods station of the Lancashire and Yorkshire Railway. Mr. Still and Mr. Littledale asked for delay, so that non-members of the committee might study the proposal, the former expressing a belief that the projected dock will cost £700,000. The matter was deferred.

THE number of ventilators is legion, but we do not know that any one has previously hit upon the idea of making the ventilator of glass, thus affording light as well as ventilation. Messrs. C. H. Sharp & Co., 104, Newgate-street, have carried this idea into practice in their "Crown Ejector," which they are supplying to the Imperial Russian Yacht *Livadia*, described in our last number. We hope to be able at an early date to more fully describe the "Crown Ejector," not only in this special application, but as generally used for purposes of ventilation.

PATENT AGENTS are as indispensable to inventors as lawyers are ordinary litigants. If a man, who is his own lawyer, is a fool, so undoubtedly is the man who draws his own specification. Many inventors, however, require more than this legal aid; they have not the means of working their patents when acquired. Messrs. L. A. Groth & Co., here step in and carry the matter a step further, so that by their aid no meritorious novelty need fail in finding a purchaser, or, at least, being put fairly before the public.

ENGINEER SURVEYORSHIPS.

BOARD OF TRADE, MARINE DEPARTMENT.

NOTICE IS HEREBY GIVEN, that the Board of Trade are about to SELECT TWO MARINE ENGINEERS for appointment in the third class of Engineer Surveyors attached to the Marine Department. Applicants to be eligible for these appointments must have served an apprenticeship as an engineer or iron shipbuilder, must not be less than 25 and not more than 45 years of age, and must have served at sea in charge of engines for at least five years. They must also at the time of application be entitled to and at the time of appointment possess first-class (Board of Trade) certificates of competency as engineers.

The necessary "form of application for appointment" will be forwarded on a request being made by letter to the Assistant Secretary of the Marine Department, Board of Trade, London.

The applicants selected for competition will have to be examined in technical subjects by the Board of Trade officers, and the two successful candidates will then be appointed, subject to their passing a satisfactory clerical examination before the Civil Service Commissioners in:—

1. Handwriting and Orthography.
2. Arithmetic (including vulgar and decimal fractions.)
3. English Composition (moderate proficiency).

The salary of third class engineer surveyors commences at £200 per annum, and increases (subject to the Board's approval) by £10 per annum to £300 per annum: Third-class surveyors are eligible for promotion to the second and first classes, for which the rates of salary are £300 to £400 and £400 to £500 respectively.

All personal applications upon the subject of these appointments are expressly prohibited, and if, notwithstanding this prohibition, personal application is made, the fact will be noted against the name of the applicant.

Copies of all letters of recommendation, and copies of testimonials and certificates, should be attached to the "Form of Application."

The Board of Trade will not hold themselves responsible for the safety of any original papers sent with the form of application.

No application will be considered for the appointments above mentioned unless it is received at the Office of the Board of Trade on or before the 30th September, 1880.

THOMAS GRAY, Assistant Secretary.

Board of Trade, Marine Department, 3rd August, 1880.

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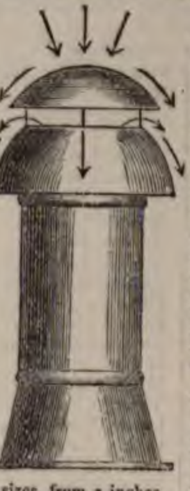

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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

The Marine Engineer,

LONDON, OCTOBER 1, 1880.

EDITORIAL NOTES.

THE transformation and surprising development that is now going on in the mercantile marine, is so remarkable as to merit our closest attention. Some twenty or twenty-five years ago, iron was being looked upon with the greatest suspicion and distrust by the mercantile world at large for use in shipbuilding; and so late ago as 1875, many Americans and Canadians have done their best to prove the inferiority of iron compared with wood for shipbuilding purposes. One ingenious American shipbuilding authority undertook to demonstrate that the floatation furnished by lightness of material "in the wooden ship was more valuable for carrying purposes than that furnished by cavity" in the iron ship; and that the elasticity of the textural fibres of the wood gave far greater trustworthiness than iron could ever give. Another American gentleman says, "it is fearful to see how these iron vessels are being put together, and more fearful to witness the blind trust in them by the whole world." It is, no doubt, a fearful thing for those who had all the facilities for shipbuilding in timber to have seen a material in which they could not hope to compete rapidly displacing the timber for the construction of the mercantile marine. Whatever the blind trust of the populace or shipowners might be, which to say the least is not complimentary to an extremely shrewd body of men, Lloyd's Register at least is very far from putting a blind trust in anything new, and the reliability of any new system has to receive a very strong practical proof before it is acknowledged from a pounds, shillings, and pence view, by that very conservative and shrewd inspecting body. It is now a pretty self-evident fact that iron, and probably steel in the near view, are rapidly wiping wooden vessels completely out of the mercantile marine. As a proof of this, we may mention that in 1879, 310,875 steamships were added to the ports register as against 99,929 steam sailing vessels. It is not only in the transformation of material, but also in the increase of size in the new mail and other steamers that the progress is so marked. Twenty years ago the principal mail services were carried by steamers averaging under 1000 tons, and perhaps 100 to 200 nominal horse power. We have now, as is well known, many of our first-class liners at present running with tonnage from 3,000 to 4,000, and of from 5,000 to 6,000 indicated horse-power, and we need only refer to the Inman Steamship, the *City of Rome* now building, as illustrated and fully described in our last issue, to show what may be expected in the immediate future.

IN view of the rapid and enormous increase ot length which is now being adopted in the construction of our fastest and largest liners, it would be well, in our opinion, if more thought was given to the relative advantages of length or breadth of beam in sea going merchant steamers. We cannot see that the extreme lengths now in vogue give any decided advantage to the steamers so built, except for passenger accommodation, and even then only from our present possibly perverted point of view. The late Professor Froude's investigations upon the surface friction of long hulls have gone very far to explode a former mistaken notion that breadth of beam was disadvantageous for acquiring great speed. It has been practically proved in the case of racing yachts that great breadth of beam with proper lines, is by no means incompatible with the highest qualities of speed. The opposite extreme of enormous breadth of beam with special lines will be watched with great interest in the case of the Czar's yacht, the *Livadia*. Extreme length cannot but increase the inherent weakness of a hull to transverse strains, and the necessary precautions against this weakness must greatly increase the quantity of material in construction, or the vessel is sadly liable to break its back. A long vessel will certainly not lift with the freedom of a short one to an on-coming sea, thus, although reducing the pitching, rendering it liable to be swept fore and aft by a heavy sea. Nor can the handiness of a long vessel for turning rapidly be so great as that of a proportionately shorter vessel, which, in the latter case, might very often be the means of escaping a disastrous collision. All this, to our mind, requires further discussion and consideration than it at present receives, as the very long and handsome new liners are being built upon principles of relative length and breadth, which modern scientific investigations may have considerably modified.

IN spite of the powerful agitation which is being brought to bear upon the Government—in which we have borne our share—in drawing their attention to the relative merits of breach and muzzle loading and wrought iron and cast steel guns, the manufacture and testing of gigantic guns proceeds without hesitation or consideration. Four 100-ton guns purchased from Sir William Armstrong, and of his well-known form of construction, are to be mounted on the defences of Malta and Gibraltar, and as they are to be loaded by hydraulic machinery, it has very sensibly been thought advisable to thoroughly test the apparatus before sending them away. The result has been that, although the mechanical appliances worked with perfect ease and celerity, the system of muzzle-loading has again, to our mind, received a severe shock. First the wooden wad fitted to the cartridge to support it, was left in the gun after one discharge. This was not noticed as the gun was again loaded, the wooden wad being thus rammed home into the breech and preventing the charge from firing. The charge had thus to be withdrawn and the breech examined, when the obstruction was discovered, and after some trouble removed. Pleasant this for an action, when the battle might depend on rapid firing. In the second place, it was noticed that one of the discharges was of considerably less resonance, and the shot projected with less velocity, and only half the penetrative power. It was concluded that this result had been occasioned by the shot slipping forward when the muzzle was still depressed after ramming. A pleasant liabillty is this also in the course of a naval combat, when every shot is required to do its utmost. It is surely needless to point out that in the case of a breech-loading gun neither of the above accidents would have been possible. Any obstruction left in the barrel would be in front of any succeeding charge, and would be visible at a glance through the open barrel, and, if loaded by depressing the breech, as is done with the muzzle at present, the whole cartridge and shot is bound to remain home at the breech.

WE find we must qualify our remark that the energetic representations on the part of ourselves and others—that our present large marine ordinance is far from being all that could be desired—has borne no fruit, as we see it just announced that it has been finally determined to arm the double-turret ship *Colossus* with breech-loading guns. This is cheering, as now it is to be hoped that the system of breech-loading at least will obtain proper trial and investigation. The loading will be performed below deck by a new system of hydraulic gear supplied by the Elswick firm, the peculiarity being that the rammer will rise with the powder and shell from below, and after performing its work will sink and leave the deck flush and clear. It is also refreshing to note the very unspairing criticism that the present autocrat of the ordnance department, viz., General Campbell, is receiving at the hands of able contemporaries. It is certainly out of all character that a comparatively unknown military artillery officer should be able to dictate—as General Campbell has done for years—to the British Navy what guns they are to use and how they are to work them. For such a post it would at least seem more in character that there should be an independent Board largely composed, at any rate of naval officers who should be entirely free from prejudice in favour of any arm, but be open to entertain suggestions or trials from all quarters, their only aim being to secure the best possible arm for the service. As Mr. Smith, the ex First Lord, has had the pluck to tell the nation that foreign navies are in many instances armed with better guns than ours, it is probable that some vital alterations will soon be made.

THERE seems to be a very strong feeling in America that the Darien or Panama canal will not pay. This has been confirmed from statistics by Mr. Joseph Nimmo, jun., the chief of the United States bureau of Statistics. He seems to have adopted a very sensible and business-like course in his estimate of the probable returns of the canal by comparing it as closely as possible with the Suez canal. He seems to have investigated and absolutely received reports from ship owners as to the probability of their adoption of the proposed canal throughout the Pacific sea-board of America. He has also obtained good reasons for believing that the shipping engaged in the guano and nitrate trade on the coasts of Peru and Chili, which now use the Cape Horn route would continue to use that route in spite of the existence of the canal. As this shipping represents some 1,200,000 tons annually, it is an important item. He has found also that the commodities formerly shipped from San Francisco *via* Panama to New York have fallen from $70,202,029 in 1868 to $4,947,755 in 1879, and the number of passengers from 26,853 in 1869, to 4,496 in 1879, the bulk now passing by the trans-continental Pacific Railroad. Taking these results all round he thinks that only 2,938,386 tons of shipping annually could be reckoned on as likely to pass through the American Canal. In the case of the Suez Canal, estimating on the same lines, 6,313,742 tons might have passed through in 1878, in reality only half that amount did so. From this Mr. Nimmo concludes that of his above estimate of nearly 3,000,000 tons likely to pass through the American Canal, only a half could be relied on to do so. As this would be only a half of that passing in 1878 through the Suez Canal, the commercial deduction is obvious. We should, however, like to see this project put to the test.

AN IRON LIGHTHOUSE.—Messrs. Morris, Tasker & Co., of Philadelphia, who have a contract for the ironwork, weighing 240 tons, for a new lighthouse, to be built at Cape Henry, Virginia, have the base of the structure finished, and the first and second story nearly completed. The castings and machinery have been made for the upper stories, and the operation of erecting the lighthouse at the Pascal Works, prior to its delivery to the United States Government, will not be long delayed. The lighthouse is to cost 100,000 dols. and will be of iron. The tower, which is octagonal, contains six stories, and is 155 ft. in height. The base is 36 ft. in diameter, tapering off to about 24 ft. at the top. The tower will rest on a base of corresponding form, of concrete mass, 8 ft. below the surface, and fastened to it by 24 ft. wrought-iron anchor bolts The outside shell will be of cast iron and the inside pyramid of wrought iron, inside of which will be the stairway leading to the lantern. The house will be built on a point some distance from the old one now in use. The present lighthouse was built in 1789, and is considered unsafe. It is of stone, 82 ft. above ground, and is rated as a second order light. The new one will be a fixed white light with a first order lens. The concrete and other work will be carried out by the United States Government, under the direction of General Babcock, engineer of the Fifth Lighthouse District, who is at present supetintending the construction of temporary buildings for the workmen, and has just completed a long wharf for landing materials.

THE AMERICAN RIVER PADDLE-WHEEL STEAMBOAT "MARY POWELL."

By CHIEF ENGINEER ISHERWOOD, U. S. Navy.

THE *Mary Powell* is a typical example of the American paddle-wheel steamboat employed on the rivers of the Eastern portion of the United States. The hull is of wood, coppered, and is exceedingly light and shallow, depending for strength on an immense timber truss, or "hog-frame," erected on each side, and on a very deep keelson supporting, along the centre of the vessel, poles rising many feet above the roof of the saloon, from the tops of which sloping iron rods suspend the guards and ends of the hull. Of course, such a structure is suitable for smooth water only, and the elegant saloons erected upon it, of light joiner-work, afford spacious and convenient accommodations for the crowds of passengers carried.

The *Mary Powell* plies between New York City and Rondout, on the Hudson River, a distance of about 88 statutemiles, making the round trip once a day during the summer "season" of each year, extending from about the middle of May to the middle of October. She carries passengers only, and her trips are made with great regularity, the times of starting and stopping varying but a few minutes from her schedule time. Her draught of water varies very slightly also, and her speed throughout the entire run may be taken, without sensible error, as absolutely uniform. The air resistance of the hull, must, at its high velocity, be considerable, as the top of the saloon is about 30 ft. above the water, while the immersion of the hull, exclusive of the keel, is only 6 ft.

There is but one engine—placed in the centre of the vessel and bolted to its keelsons—and it is as typical as the hull, being a first-class specimen of the overhead beam, or "walking-beam," kind, used exclusively on such steamboats, the beam being supported upon a lofty triangular gallows-frame of wood, very stiff and very light. The boilers, also, are peculiar to this style of steamboat. They are two in number, and placed outside of the hull upon the projecting guards behind the wheel-houses. This is the only place available for them, and as no more boiler space can be obtained than there is room for on these guards their rate of combustion has to be forced enormously by powerful fan-blowers to furnish sufficient steam for the large power required. Independently, too, of the limited space that can be devoted to the boilers, no greater weight of them can be allowed, even if more space was available. Anthracite of small nut size is burned, giving about one-sixth refuse. The vessel is coaled at Rondout, and carries just enough for one round trip. The paddle-wheels are of the usual radial kind. For river steamers carrying large numbers of passengers, no system, as a whole, has ever been devised equal to the paddle-wheel steamboat of the *Mary Powell* type.

The entire machinery with its appurtenances, including the water in the boilers, weighs about 210 tons; the coal embarked weighs about 30 tons; total in the engineer department, 240 tons, or 27·24 per centum of the vessel's displacement.

As there is no account to be found of the performance of such a vessel, my friend, the accomplished engineer, Mr. Theron Skeel, having occasion to make many trips in the *Mary Powell* during the summer of 1877, kept for me an accurate record of her running time between the cities of New York and Newburgh, 59 statute miles apart, together with the boiler pressure, vacuum, temperature of the feedwater, revolutions of the motive and blowing engines by counter, consumption of coal, etc., the coal being the amount purchased by the owner of the boat. He also took on each trip a large number of indicator diagrams from both ends of the cylinder, and made the other observations to be found in this article. The means from all these diagrams are given in the table of "performance."

During the round trip no water was blown from the boilers, and they remained entirely free of scale. There was no means of ascertaining the temperature of the gases of combustion in the chimney, but a piece of zinc suspended therein at the level of the top of the steam-drum melted promptly, showing the temperature to be above 750 degrees Fahrenheit. The temperature of the steam in the boiler, considered as saturated steam, would be 272 degrees Fahrenheit or more than 478 degrees Fahrenheit less than that of the gases of combustion passing through the steam-drum, which difference, taken in connection with the large extent of surface in the drum and upper part of the uptake, must have caused a considerable steam superheating. There was no means, however, of ascertaining this fact quantitatively, but it is believed that the superheating was sufficient to prevent any steam condensation in the cylinder other than that due to the development of the total horses-power.

In the table of "performance" hereinafter given will be found grouped all the quantities observed and calculated. The power developed is that of the motive engine alone, exclusive of the power exerted by the blowing engines in driving the fans. Of the latter power no approximation can be made, as these engines used the steam greatly throttled but exhausted into the condenser. The weight of steam used, calculated from the indicator diagrams, is also exclusive of the weight consumed by the blowing engines: hence, if it be assumed that there was no condensation in the cylinder of the motive engine other than that due to the development of the total horses-power, then the cost of the horses-power in weight of steam consumed per hour can be ascertained. As the motive engine developed 1744·884 total horses-power, and as the indicator accounted for 38258·264 pounds of steam consumed per hour in its cylinder, there follows that the total horse-power was obtained for 21·93 pounds of steam consumed per hour.

The economic vaporization by the boilers can be ascertained, without error of practical importance, by assuming the weight of steam consumed by the blowing engine to be five per centum of the weight consumed by the motive engine. Adding this weight to the 38258·264 pounds of steam consumed by the motive engine per hour, there results 40171·177 pounds of steam evaporated per hour, from water at the temperature of 120 degrees Fahrenheit, and under the boiler pressure, by 6050 pounds of anthracite, or 6·64 pounds of water vaporized per pound of coal. This, of course, supposes no condensation in the motive cylinder, which was probably the fact, an inference warranted by the superheating of the steam, by the above cost of the total horse-power in pounds of steam consumed per hour, and by the boilers' economic vaporization of 6·64 pounds of water per pound of coal consumed at the great rate of 39·286 pounds per square foot of grate surface per hour.

In computing the quantity of heat transformed into the total horse-power developed by the expanded steam, the mechanical equivalent of the heat required to raise the temperature of one pound of water from 32 to 33 degrees Fahrenheit is taken at 789¼ pounds, instead of Joule's equivalent of 772 pounds. The latter has long been known to be too small, and the former is the result of the experimental researches of Tresca and Laboulaye, endorsed by Regnault, Piobert, Combes, Bertrand and Morin. It should be universally adopted.

HULL.

Length on the load water-line from the forward edge of the rabbet of the stem to the after edge of the stern-post	290 ft.
Extreme breadth on the load water-line	34 ft.
Depth of hold from top of floor-timbers to under side of deck-plank	9⅓ ft.
Depth from load water-line to lower edge of rabbet of keel	6 ft.
Depth of keel below the lower edge of its rabbet ...	6 in.
Area of the greatest immersed transverse section to load water-line	198·5 sq. ft.
Displacement to load water-line	881· tons.
Ratio of the length of the breadth	8·529.
Ratio of the greatest immersed transverse section to its circumscribing parallelogram	0·973
Ratio of the displacement to its circumscribing parallelopipedon	0·520

ENGINE.

There is one overhead beam-engine with a wooden gallows-frame. The cylinder is vertical and has four balanced poppet-valves, two for admitting and two for exhausting the steam. The steam-valves function also as expansion valves by means of the mechanism known as Stevens' cut-off. The condensation of the steam is effected in a jet-condenser. The air-pump is vertical and single-acting. The cylinder is not steam-jacketed; its ends, its valve-chests, and its side-pipes have no protecting covering, but its cylindrical portion and all the steam-piping connecting it with the boilers were well covered with asbestos felting.

During the performance hereinafter given, the steam-valves closed when 0·486 of the stroke of the piston was completed. There was but little exhaust lead, and exhaust-valves closed and cushioned the steam when the piston was at 0·232 of its stroke from the end.

Number of cylinders	1
Diameter of cylinder	72 in.
Diameter of the piston-rod	6¾ in.
Net area of the piston, exclusive of the piston-rod	4053·62 sq. in.
Stroke of the piston	12 ft.
Space displacement of the piston per stroke ...	337·802 cub. ft.
Clearance of the piston	1⅛ in.
Capacity of steam-passage or nozzle at one end of cylinder	8·488 cub. ft.
Aggregate space in clearance and steam-passage at one end of the cylinder	12·300 cub. ft.
Least diameter of the seat of the upper disc of the steam-valve	15⅜ in.
Least diameter of the seat of the lower disc of the steam-valve	14¾ in.
Least diameter of the seat of the upper disc of the exhaust-valve	14¾ in.
Least diameter of the seat of the lower disc of the exhaust valve	15⅞ in.
Area of steam-port, exclusive of valve.stems ...	352 sq. in.
Diameter of air-pump (single-acting)	40 in.
Stroke of air-pump piston	62 in.

BLOWING-ENGINES.

There are two blowing-engines—one for each boiler—employed in driving fan-blowers to produce an artificial draught. Each blowing-engine consists of one cylinder 12 in. in diameter, with 12 in. stroke of piston, geared by a belt to a Dimpfel blower 5 ft. in diameter and 32 in. wide, which makes five revolutions to each double stroke of the steam-piston. The steam is cut off by lap on the steam-valve at three-fourths of the stroke of the piston from the commencement.

The delivering-nozzle of each fan-blower is connected by a rectangular conduit of sheet-iron with the closed front of the two ash-pits of its boiler, and they receive the air-blast beneath the grate-bars.

BOILERS.

There are two boilers, one placed on each guard of the vessel immediately behind the wheel-house. They have lower flues in direct continuation of the furnaces, with tubes returned above the flues and furnaces. The two boilers have no connection of any kind; they have separate chimneys, are fed separately with both water and air-blast and deliver their steam through separate pipes into one large steam-pipe. The external surfaces of the boilers are well covered with asbestos felting. The following is a description of each boiler:—

The front portion of the shell is rectangular in plan, with flat sides and a semi-cylindrical top. The back portion is cylindrical, with its top a horizontal continuation of the top of the semi-cylinder of the front portion. The front portion is 10 ft. 9 in. high, exclusive of water-pan beneath the grates, 8 ft. 11½ in. long, and 11 ft. wide. The back portion is 10 ft. in diameter and 16 ft. 1 in. long, with its bottom 9 in. above the bottom of the front portion.

The furnaces are two in number, each 4 ft. 9¾ in. wide by 8 ft. long. The crown is an arc of 7 ft. 3 in. radius, joined to the vertical sides by quadrantal curves of 8 in. radius. The flat water-space between the furnaces is 6½ in. wide, and between the furnaces and shell 5 in. wide, including thicknesses of metal.

The opening for the furnace door is semi-circular on top, 22 in. wide and 22 in. high. The height from the top of the grate-bars to the top of the furnace is 3 ft. The bridge-wall is 7 in. wide, including thicknesses of metal.

Immediately behind the bridge-wall is a combustion-chamber, separate for each furnace. Its extreme height is 3 ft. 2 in. and its length is 3 ft. In cross-section its outline follows the side and top of the furnace, the curve of the lower flue and of the cylindrical part of the shell, from which it is separated by a water space 3½ in. wide including thicknesses of metal.

From the combustion-chamber to the back smoke-connection there proceed, for each furnace, three lower horizontal cylindrical flues of 16 in. inner diameter, one lower horizontal flue of 14 in. inner diameter, and one of 9 in. inner diameter. All these flues are 9 ft. 1 in. in extreme length. The least water-space between them is 4½ in., including thicknesses of metal.

The back smoke-connection is in common for both furnaces. It is flat on the top, and on the sides and bottom is concentric with the cylindrical part of the shell, from which it is separated by a water-space 3½ in. wide, including thicknesses of metal. The extreme height is 6 ft. 4 in., extreme breadth, 9 ft. 5 in., extreme length, 3 ft. 7½ in., all in the clear. The flat water-space between the end of the connection and the shell is 4½ in. wide, including thicknesses of metal. Access is had to the connection through a manhole of 18 in. diameter in the back end of the boiler.

From the back smoke-connection to the uptake there are returned over the lower flues and the furnaces 80 horizontal fire-tubes of 4½ in. outside diameter and 4·30 in. inside diameter; length, 16 ft. 6 in. The tubes are distributed in 5 rows vertically and 16 rows horizontally. The least distance from centre to centre of tubes, both vertically and horizontally, is 6·357 in. The space in the clear, between the bottom of the lower row of tubes and the furnace-crown, is 7 in. The height from the top of the upper row of tubes to the bottom of the lower row is 2 ft. 4 in. The heating surface of the tubes is calculated for their inside circumference, which is also the case for the flues.

The uptake is in common for all the tubes. The lower portion is rectangular, 8 ft. 8 in. in extreme breadth, 55 in. in extreme width to the front of the shell and 31 in. in height. It is fitted with the usual uptake doors, giving access to the tubes for sweeping. The upper portion is irregularly shaped, drawing in to a circle of 50 in. diameter at the top of the shell.

From the top of the uptake rises the chimney, 50 in. in inner diameter. The lower portion of the chimney, for a height of 12 ft. above the top of the shell, is surrounded concentrically by a steam drum of 90 in. diameter, with a flat top. The portion of the chimney so surrounded, together with the upper portion of the uptake, is steam superheating surface.

All the flat surfaces of the boiler are braced every 7 in.

The following are the principal dimensions and proportions:—

Number of boilers	2
Extreme length of boiler, exclusive of projecting steam drum	25 ft. ½ in.
Extreme height of boilers, exclusive of steam-drum	10 ft. 9 in.
Extreme breadth of boiler	11 ft.
Height of steam-drum above the boiler-shell ...	12 ft.
Projection of steam-drum forward of the boiler-shell	1 ft. 3½ in.
Total number of furnaces	4
Width of furnace	4 ft. 9¾ in.
Length of furnace	8 ft.
Aggregate area of grate surface	154 sq. ft.
Number of lower flues	20
Length of lower flues	9 ft. 1 in.
Inner diameter of lower flues,	4 of 9 in., 4 of 14 in. and 12 of 16 in.
Number of tubes (iron)	160
Length of tubes	16 ft. 6 in.
Outside diameter of tubes	4½ in.
Inside diameter of tubes	4·30 in.
Least space between tubes, in the clear	1·857 in.
Aggregate area of heating surface in the furnaces ...	416·00 sq. ft.
Aggregate area of heating surface in the combustion chambers	220·00 sq. ft.
Aggregate area of heating surface in the lower flues	338·00 sq. ft.
Aggregate area of heating surface in the back smoke-connections	62·70 sq. ft.
Aggregate area of heating surface in the tubes ...	2971·94 sq. ft.
Aggregate area of heating surface in the uptakes, to 9 in. above tubes...	675·36 sq. ft.
Total water-heating surface	4726·00 sq. ft.
Aggregate area of steam superheating surface ...	418·00 sq. ft.
Distance traversed by the gases of combustion from the centre of the furnace to their delivery into the uptake	40 ft.
Diameter of chimneys (two in number)	4 ft. 2 in.
Height of chimneys above level of grates ...	52 ft.
Aggregate cross-area over bridge-walls, for draught	22·500 sq. ft.
Aggregate cross-area through lower tubes, for draught...	22·798 sq. ft.
Aggregate cross-area through the tubes, for draught	16·136 sq. ft.
Aggregate cross-area of the chimneys	27·272 sq. ft.

PROPORTIONS.

Square feet of water-heating surface per square foot of grate surface	30·558
Square feet of steam superheating surface per square foot of grate surface	2·714
Square feet of grate surface per square foot of area over bridge-walls	6·844
Square feet of grate surface per square foot of area through lower flues	6 755
Square feet of grate surface per square foot of area through tubes	9·544
Square feet of grate surface per square foot of area through chimneys	5·647

PADDLE-WHEELS.

The paddle-wheels are of the ordinary radial kind.

Diameter from outside to outside of paddles	31 ft.
Number of paddles in each wheel	26
Length of each paddle	10½ ft.
Breadth of each paddle	1¾ ft.
Deepest immersion of outer edge of paddles	3½ ft.

PERFORMANCE.

The following is the average performance of the *Mary Powell* between the cities of New York and Newburgh, on the Hudson River, during the summer of 1877. The running was very regular, the deviations at any time from the mean being very slight.

VESSEL.	Vessel's mean draught of water, in feet ...	6½
	Vessel's greatest immersed transverse section, in square feet	198·5
	Vessel's displacement in tons	881
	Deepest immersion of the outer edge of the paddles, in feet	3·50
	Diameter of the paddle-wheel between centres of pressure of the paddles, in feet ...	29·50
ENGINE.	Steam pressure in boilers, in pounds per square inch above the atmosphere	28·5
	Proportion of the throttle-valve open ...	0·75
	Fraction of the stroke of piston completed when the steam was cut off	0·486
	Fraction of the stroke of the piston to be completed when the steam was cushioned ...	0·232
	Number of times the steam was expanded ...	1·984
	Vapour pressure in the condenser, in pounds per square inch above zero	2·4
	Number of double strokes made by the piston per minute...	21·8
	Temperature of the injection-water in degrees Fahrenheit	68
	Tempetature of the feedwater (hot-well) in degrees Fahrenheit	120
	Number of double strokes made per minute by the pistons of the blowing-engines ..	75
	Number of revolutions made per minute by the fan-blowers	375
	Air pressure in the fan-blower conduit, in inches of water, above the atmosphere ...	1¼
STEAM PRESSURE IN CYLINDER PER INDICATOR.	Steam pressure in cylinder, in pounds per square inch about zero, at beginning of stroke ot pisten	41·42
	Steam pressure in cylinder, in pounds per square inch above zero, at point of cutting off the steam	31·34
	Steam pressure in cylinder, in pounds per square inch above zero, at end of stroke of piston	16·42
	Mean back pressure against the piston, exclusive of the cushioning, in pounds per square inch above zero	3·55
	Mean back pressure against the piston, inclusive of the cushioning, in pounds per square inch above zero	5·31
	Mean indicated pressure on the piston in pounds per square inch	24·42
	Mean net pressure on the piston in pounds per spuare inch	22·92
	Mean total pressure on the piston, exclusive of the cushioning, in pounds per square inch	27·15
HORSES-POWER.	Indicated horses-power developed by the engines	1569·432
	Net horses-power developed by the engines ...	1473·029
	Total horses-power developed by the engines, exclusive of the cushioning	1744·884
	Horses-power expended on the cushioning alone, above zero	165·812
	Horses-power expended on the cushioning alone above the back-pressure of 3.55 pounds per square inch against the piston	113·112
RATE OF COMBUSTION.	Pounds of anthracite consumed per hour	6050·000
	Pounds of anthracite consumed per hour per square foot of grate surface ...	39·286
	Pounds of anthracite consumed per hour per square foot of water-heating surface	1·280

ECONOMIC RESULTS.	Pounds of anthracite consumed per hour per indicated horse-power	3·855
	Pounds of anthracite consumed per hour per net horse-power	4·107
	Pounds of anthracite consumed per hour per total horse-power	3·467
SPEED.	Speed of the vessel per hour in statute miles of 5280 feet	19·200
	Speed of the vessel per hour in geographical miles of 6086 feet	16·657
	Slip of the centre of pressure of the paddle in per centum of its speed	16·37
WEIGHT OF STEAM CONSUMED.	Fahrenheit units of heat transformed per hour into the total horses-power developed by the expanded steam, calculated for the mechanical equivalent of one Fahrenheit unit, 789¼ pounds raised one foot high per minute	1823195·554
	Pounds of steam of the boiler pressure required to be evaporated from water at the temperature of 120 degrees Fahrenheit, to contain the above number of Fahrenheit units of heat	1895·741
	Pounds of steam supplied per hour by the boiler to the cylinder, calculated from the pressure at the end of the stroke of the piston and from the back pressure cushioned	36362·523
	Sum of the two immediately preceding quantities, or weight of steam in pounds consumed per hour, according to the indicator	38258·264
	Pounds of steam cushioned per hour ...	2365·428

THE crankshaft of the *Inman* steamer, City of Chester, fractured on her homeward voyage from New York, and powerful tugs had to be sent to her assistance.

DOCK EXTENSION IN THE RIVER THAMES.—The works for enlarging Messrs. Fletcher, Son, & Fearnall's upper dock at the Union Yard, Limehouse, E., are now nearly completed, and last week the works for lengthening, widening, and deepening the middle dock was commenced. The walls will be built of brickwork backed up with concrete; at the entrance an iron caisson will be used in place of gates; the dock when completed will measure nearly 360 ft. in length. The whole of the works are being carried out under the superintendence of Mr. E. C. Homer, C.E.

OF the nine gold medals awarded to the exhibitors at the Sydney Exhibition five have come to England. Of these two have been awarded to Sheffield firms, the one to Sir John Brown & Co., for the collection of armour plates, boiler plates, and other heavy iron and steel productions, and the other to the Hadfield Steel Foundry Company, for the collection of steel castings of almost every description, from the smallest article to the Hadfield's steel tramway wheels and other large castings.

A CORONER'S inquest has been held at Gibraltar respecting the death of the cook and two of the crew of the English steamer *St. Oswin*, who were killed by the explosion of the donkey engine on board that vessel on the 20th ult. It transpired in evidence that the safety-valves of the engine were heavily weighted at the time of the accident. A verdict of "manslaughter" was returned against the captain and the chief engineer, and a warrant was issued for their apprehension.

STOWAGE OF GRAIN CARGOES.—The *Australian Shipping News* says:—"A most pernicious practice appears to prevail at some of the South Australian ports where grain is shipped for the United Kingdom, of slashing the bags, in order, by the escape of the wheat, to obtain closer and better stowage. Already two cases—the Nevada and Hugh Fortescue—testify to the danger and inutility of such a method of obtaining stowage, and every precaution should be adopted to at once stop its continuance in the interests of humanity, as well as of underwriters. The two barques which have been put into Launceston and Melbourne respectively, with pumps choked and cargo damaged, will be but the causes of heavy pecuniary loss; but should the wheat on board these vessels not have got down among the limbers, and thence into the pumps, until they reached mid-ocean, the casualties might easily have been of a far graver nature, and attended witn loss of life."

THE PRACTICAL CARE OF MARINE BOILERS.

BY A SEA-GOING ENGINEER.

THERE is no subject of more vital interest to the shipowner, or of more earnest anxious thought to the sea-going engineer, than that of the care and the welfare of the marine boilers, which form part of the property of the one, and which engage all the thoughts and all the attention of the other. We constantly see certain systems of management being adopted by the advice of one consulting or inspecting engineer, utterly at variance, and contradictory to the practice of another equally well known, and equally eminent member of the profession. For example, one engineer will advocate the continual changing of water in the boilers; while another declares this to be the most ruinous course it is possible to pursue. Again, Mr. A. will desire that tallow should be used with his engines, and finds the use of it, if not advantageous, certainly not the contrary, to his boilers; and Mr. B. asserts that of all causes which tend towards the deterioration of boilers, there is none so fraught with ill as the use of tallow as a lubricant. So it is that doctors differ and boilers die. There is one very strikingly noteworthy feature to be observed on this subject before going away further, and that is, that where one might naturally expect to find boilers most cared for and most carefully treated, we find the result to be most unsatisfactory, for there can be no doubt that the boilers on board of the ships of Her Majesty's Navy are more short lived, and more universally unsatisfactory, than they are in the mercantile marine. This may or may not be the fault of those in charge; but that it is a fact is undeniable.

Unfortunately, all boilers in the merchant service are not well used. Large numbers of engineers are careless. As an example of what want of care may do in the treatment of hard-worked boilers, the writer may cite a case which came under his notice a short time ago. There are a few steamers plying constantly between the Tyne and New York, carrying coal or chemicals out, and bringing cattle home. These steamers are worked very hard and constantly, but during the "lies" which they get whilst loading or discharging at their ports ample time is afforded to the engineers for overhauling and examining both engines and boilers. The boat under notice was supplied with a pair of new boilers some two years ago, and since that time they had worked fairly well, although they were much neglected, and apparently never examined by either the superintending engineer or the chief. Some few months ago the chief—who had been with the ship since her new boilers were put in—left on a plea of illness, and the day before the ship sailed a new engineer was appointed. Not getting enough cargo in the Tyne, she went on to finish loading at Dundee; but before sailing, the superintending engineer advised the chief to examine his boilers if possible at Dundee. Before reaching that port a small hole appeared in the crown of one of the furnaces, causing the utmost difficulty in keeping the fire going. On reaching port the chief engineer blew down only the partially disabled boiler, and drilled a hole through the leaky place in the furnace, from the inside of the furnace, never thinking of taking his manhole door off to examine the other parts of that same boiler. A stud having been screwed into the affected spot, the engineers rested on their work, waiting till the ship was ready to start. By good luck New York was in safety reached, and in due course the chief did go into the boilers, when he found them in a deplorable state of corrosion, the crowns of three of the furnaces being pitted and grooved almost right through the iron. The poor chief was sorely troubled in his mind when he saw that he had miraculously crossed the Atlantic with 70 lb. of steam in such a pair of boilers, but he determined to keep his head out of the lion's mouth again, and forthwith he went to a firm of New York boiler makers, and gave them a grand comprehensive order to cut out every plate they considered defective, and replace it with a new one. The ship was of course delayed, and the New York firm charged the sum of £1000 for their labour. The plates which had been cut out were brought home. The three furnace crowns were very badly corroded, but all on the inside—that is, the corrosion appeared on the side of the crown of each furnace next to its fellow. The New York firm of boiler makers, instead of taking the crown plates off altogether, substituting new ones, cut each of the crowns along the centre, and rivetted on a new half crown, the seam of rivets being thus immediately above the fire. It is needless to make any remark on this point; enough to say that the boilers had to get new full crown plates as soon as the boat reached the Tyne. In all some fourteen plates or pieces of plate had been taken out, the great majority of which would have lasted well, with a few studs tapped into the most dangerous pits, until the ship had reached home, where the work would have been done far better and far cheaper. Probably no one was more surprised than the superintending engineer when he heard of the repairs necessary at the other side of the Atlantic.

That the life of a boiler depends very largely on the way in which it is built is certain. Not only does this statement refer to the excellence of material and of workmanship, but to the care taken in designing a new boiler that every possible part is accessible for cleaning or for examination, and that the proportions each part bears to its fellow, and to the whole, have been properly calculated. Engineers having to design boilers should be particular that the boiler shall be fully adequate to perform the work it is called upon to do. Some few months ago the writer was sent on a voyage of inspection on board a steamer which had given dissatisfaction for several months, indeed ever since new boilers had been put in. The consumption of coal was stated to be something enormous in proportion to the speed and the carrying capacity of the ship. The safety valves of these boilers were loaded to 75 lb., but more than 50 lb. it was very difficult to obtain. The writer found that it was impossible to keep steam above 50 to 55 lb., though with clean fires at the beginning of the watch 60 lb. might be touched. On indicating the engines they were found to be doing just 400-horse power. On examining the boilers it was found that the furnaces and tubes were covered with a very thick scale, in no part less than $\frac{1}{8}$ in., and in many parts up to $\frac{3}{16}$ in. On measuring the boilers they were found to be much too small for the engines. The builders of the engines and boilers were written to for their explanation, and their answer was that the managing director of the company had so hampered them with conditions and limited them as to sizes, that it was he himself who in fact, and in truth, had designed the boilers. These boilers, bad as they were, had never been cared for, and the chief engineer in charge of them said that since they were new he had never been able to get steam, and that the quantity of scale made no difference!

As to the advantage of a certain quantity of scale, all engineers are agreed, for as this scale is perfectly impervious, it shields the surface of the iron from the corrosive action of the water; but that this scale may not interfere materially with the heat thrown out by the fires, it is highly necessary that it should be limited in quantity, and ought never to be allowed to become thicker than a sheet of stout paper or at most a sixpenny piece; if allowed to become thicker than this on such vital parts as the crowns of the furnaces or the plates of the combustion chamber, it interposes an impregnable barrier between the water and the plate, and so causes, or at least allows, the fires to burn the plates until some disastrous result follows. An engineer's first object on going to sea with new boilers should be to get a thin protective scale to form over the interior, or at least over such parts as are of the most vital importance; this can be very easily done by allowing the water in the boilers to become more dense than is ordinary sea water. If a density equal to twice that of sea water is obtained, a nice thin scale will be deposited, but in a boiler if there is any place on which rust exists no scale will form. Where scale does form, no corrosion can take place. As soon as the engineer is satisfied that he has a good scale deposited, he may reduce the density of his water, but it is not advisable to reduce it below the density, because when the water falls the scale will all crumble off. The writer is at present supposing that the engines in use are surface-condensing, for the old-fashioned jet-condensing engines were not nearly so severe on boilers. The reason of this, however, is not to be found in the difference between surface-condensing and common jet, so much as in the fact that in the one case the steam is of a very high pressure, while in the other case the pressure was low. Once at sea, and with a nice scale deposited, it is necessary to treat boilers with the utmost care. The writer has found it to be of great advantage to blow the boilers down, say, half an inch in the glass during alternate watches, scumming them to about the same extent during the other watches. By this means the density of the water is maintained; all floating dirt or scum is disposed of by the scumming, while the blowing down gets rid of the dirt which will accumulate at the bottom of the boiler. The introduction of lime water into boilers as a preventive of corrosion has been very strongly advocated, and is much practised on board the steamers which sail from the eastern side of England. The operation is very simple. Take a bucket of water, and into it put about a quart full of unslacked ordinary lime, stir it well and leave it to settle, which it will do in a couple of hours. As soon as the lime has all fallen to the bottom of the bucket, pour off the clear water which remains, and introduce it into the boilers by means of the feed pump. The water is put into the hot-well through a cock which is generally provided for the purpose. That lime thus used checks corrosion there can be no doubt, and boilers so treated are found in excellent condition even after years of working. So wherever the least sign of pitting—the first stage of corrosion—is, this lime so introduced finds its way, and acts as a powerful antagonist to corrosion. What is this same corrosion of which we hear so much? In the writer's opinion it is caused in the greatest degree by the galvanic action set up between the tubes of the condenser or the feed pipes—generally of copper—and the iron of the boilers; in some measure by the plates not being covered by scale, and very often by mechanical impurities, such as slag, dirt, &c., in the iron. There is no doubt a very destructive galvanic action set up between copper and iron, and so copper is lately but little used in condenser-tubes, most engineers preferring the use of brass, which is much less vicious in its action. When these tubes have been tinned, the action is reduced to a minimum, and the most satisfactory results have followed in the longevity of the boilers. Iron feed pipes have been tried, but they have not been successful, and will not stand any length of time; indeed the engineers who adopted them have been obliged to fall back again on the original copper feed pipes. How particles or atoms of copper are transferred into the boilers is a point which has puzzled and is still puzzling the most experienced engineers of our time, but the general opinion leads us to believe that it is the use of tallow or some saponifiable oil which causes this; this tallow or oil coming from the cylinders and slide valves deposits on the condenser tubes, and in the feed pipes, and while it remains on it gradually changes into a green compound which contains copper in an oxidized state, and of this a great quanitity goes into the boiler with the feed. Many lubricants have been patented and are used which will not have a bad effect; amongst others we have Crane's oil and valvoline. The former is an admirable lubricant, but must be used with the greatest caution, a tablespoonful or thereabouts being quite enough for a watch; its danger consists in that, if used unsparingly, it deposits a very thin scale of its own on the furnace crowns, and on the combustion chambers, which is a perfect non-conductor, and will operate powerfully in bringing furnace crowns down. But the writer has found glycerine for the cylinders and slide valves, if it is good and pure, to be by far the most satisfactory lubricant he has seen. A somewhat remarkable case may be cited, and if it proves nothing, it is a somewhat interesting fact in connection with the use of Crane's oil as against glycerine. The writer got orders from a superintending engineer to place a plate of zinc in each of his boilers, and for this purpose plates weighing about 32lb. each were supplied. Now, knowing that were these plates hung on to the stays, as is the usual method, they would very soon break to pieces, and falling to the bottom of the boilers be blown out by degrees, they were placed in horizontal dishes, which were made of sheet iron for the purpose, and fastened to one of the longitudinal stays between the furnaces, great care being taken to secure a metallic continuity by means of a shoe fitted round the stay and screwed through the plate and its dish. The ship sailed to America, the boilers being very regularly blown down or scummed each watch, and about six buckets of lime water were sent in each day. On arrival in port the boilers were examined and found to be perfectly in order, the zinc, though a good deal altered, being still intact. The boilers were closed up, and the ship returned; when, after a voyage extending over two months and a-half, they were again examined. They were still perfectly satisfactory, the zinc, though all still remaining, being so very much altered that the superintending engineer advised the substitution of another pair of new plates. Now during all these two months and a-half nothing but glycerine had been used in the cylinders. The next voyage was a short Baltic one of only five weeks' duration, and at its conclusion, when the boilers were examined, not a trace of the new zinc plates was remaining, though only half the time had passed which the others had lasted, but during this voyage Crane's oil had been used instead of glycerine. There is not doubt that when zinc is properly applied—that is, metallic continuity having been assured—it protects iron and steel from corrosion.

The Commission appointed by the Lords of the Admiralty to inquire into the causes of the deterioration in boilers, have made very elaborate experiments as to the use of zinc as an anti-corrosive agent, and on the point of its use they are emphatic, when we read—"Apart from any consideration as to the existence of any galvanic action in boilers, the protective value of zinc may be stated as follows: If a boiler is worked in the ordinary manner with sea water, its exposed surfaces will be vulnerable to the action of all the corrosive influences which may be present capable of affecting iron; but if zinc be introduced and applied in the manner which has already been pointed out, *i.e.*, perfect metallic continuity insured between it and the iron, galvanic action is set up between the two metals, and the latter is compelled, by the presence of one of a more electro-positive nature, to assume a negative condition towards corrosion or oxidation. Such being the case, the metallic condition of the iron is preserved at the expense of the zinc, which loses in course of time its metalic nature by oxidation, in which latter condition it ceases to afford protection, and must, therefore, be renewed at intervals.

If the dirt and grease which gets into the condenser exerts itself in any way disadvantageous to the life of the iron in the boilers, it will be very readily acknowledged that the keeping of the condensers clean will fulfil a twofold object, insomuch that in addition to preserving the boilers, the power of the condenser is maintained more perfectly as a vacuum creator. This object can be very easily reached by occasionally injecting a cleaning compound into the steam side of the condenser. When coming into port with a ship, if it is found necessary to lie anchor for any time whilst waiting for the tide, is the most satisfactory time for this. Mix up in a bucket a very strong solution of "alkali" and common soda, and when the engines have been finished with, and before the vacuum is lost, it is an easy matter to introduce this mixture through a cock, generally supplied for the purpose on the condenser. Six or seven buckets of this mixture may be so introduced, and the suctions to the feed being carefully shut will prevent any of it reaching the feed pipes. Whilst the engines are standing the boilers may be pumped up to three-quarter glass, and allowed to remain so as long as possible. As soon as the engines are again started, if the feed suctions are left shut hard down, the water already in the boilers will amply suffice to carry on for at least two-thirds of an hour, and the overflow pipes will relieve the condenser of all the steam which may be used, as well as of all the dirt, grease, &c., which the alkali and soda will have softened and caused to come away freely. If this can be done occasionally, the condenser will be maintained at a high state of efficiency, and the boilers will very materially gain by the expulsion of so much of the dirt which would otherwise have entered them.

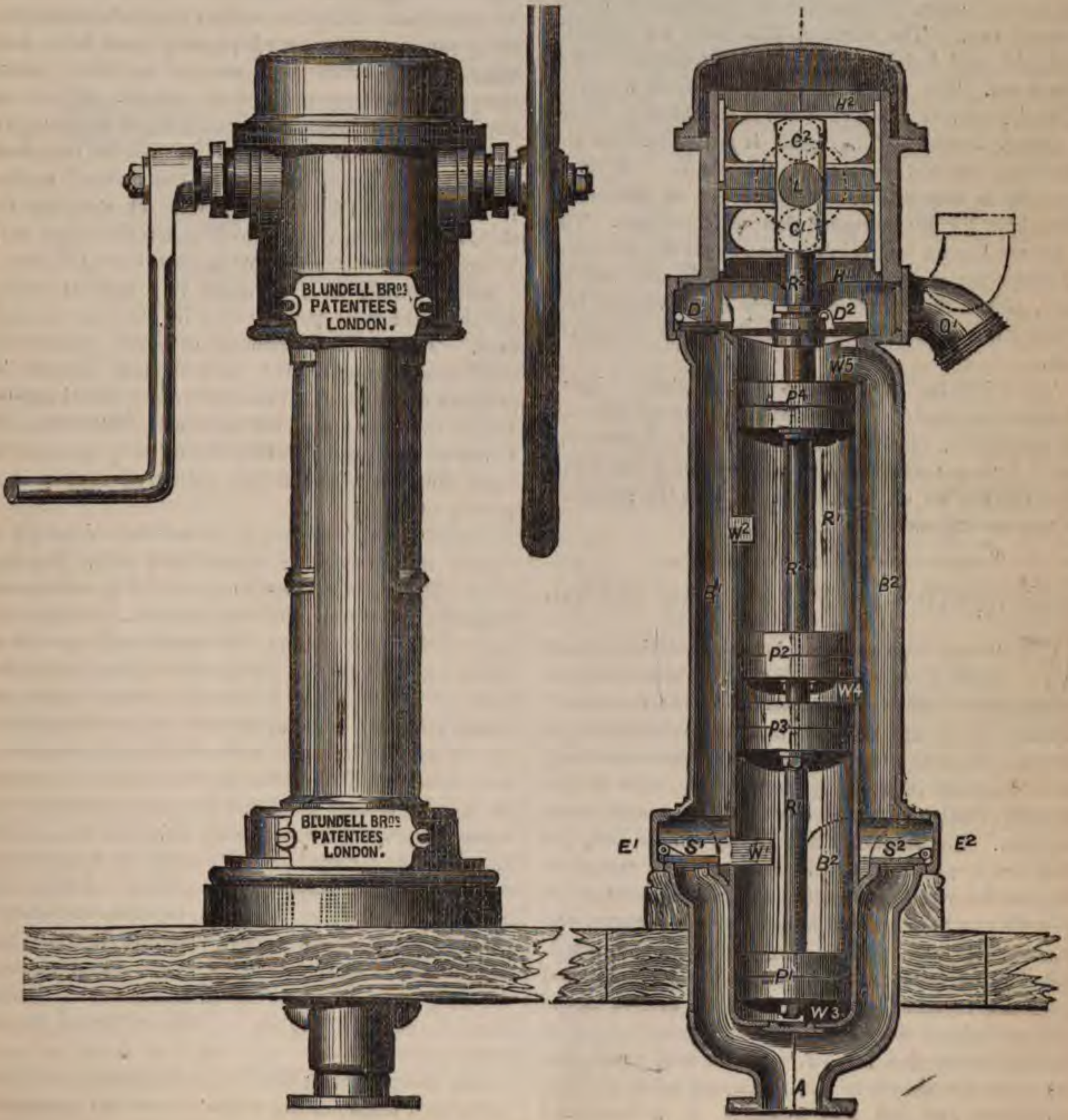
On reaching port it is well to change the water entirely in the boilers, and indeed, in order that the boilers may be cleaned, it is imperative that the water be got out of them. The word "got" is here used advisedly, for the operation or mode of getting it out is a very debatable question. Most engineers advocate that the steam be worked off through the safety-valves, and when there is no pressure, that the boiler doors be knocked in, and the water allowed to run into the bilges. Now this a lengthy operation and an inconvenient one, in that the bilges become full of water, always an objection, and amounting to very serious objection, should the ship happen to be in port when the winches are not being used, there being no steam wherewith to pump this water out. A better plan is as follows :—As soon as the engines are finished with, lift the safety valves, so that they may blow freely, and so soon as the pressure has fallen, say from 75 lb. to 50 lb., open the blow-down cocks, the greatest care being taken to see that not a single live coal is left in any furnace. Let the boilers blow until the water inside is almost level with the furnace crowns, when shut the cocks. The safety valves being kept still up, the pressure will very soon disappear and the doors may be knocked in, when only a small quantity of water will remain to flow into the bilges, and the evils of having full bilges, or of shaking the boilers too much by blowing them right down, will be overcome. The man-hole and sludge-hole doors being off, a draught will get though the boilers, and next morning they will be quite cool enough for men to work in them. The men should be provided with hand brushes and hand scrapers, which being judiciously used will soon remove all that need be taken out. Chisels or scaling hammers should never be used, for the boilers should never be allowed to get into a state when the use of these tools becomes unavoidable, except under the most exceptional circumstances. The boilers being carefully brushed out, a hose is to be next introduced, and every part of them must be washed down. When this operation is concluded, the water is to be dried completely out, the more perfectly the better, and for this purpose a very simple and most efficacious plan may be adopted, which is to light a fire of wooden chips or straw in the furnaces, and if the damper in the funnel be closed, the heat from these pieces will soon dry the interior of the boilers completely. If there is any sign of pitting, it will now most likely be found in the surface of the plates under the furnaces, and whether pitting is there to be found or not, the greatest care should be taken to protect this most valuable part of a boiler's anatomy. Various plans have been adopted for this, some engineers brushing very thin Portland cement over the surface, others paying the whole of the surface of the interior over with boiled oil, some again using various patent cements, but there are very few cements which beat a mixture of Portland cement and coal tar; this may be put on to the thickness of 1½in, for, say, 2 ft. to either side of the centre line, and if care is taken that no air space is left between the cement and the plate, very satisfactory results will follow. Boilers so treated and cared for by the engineers in charge of them have thus, with a small expenditure of time and trouble, given every satisfaction to the owners and to the builders; they have been a pleasure to those in more immediate charge, instead of being the extreme opposite, and there is no work which firemen at sea more cheerfully and more zealously perform—the cleaning of bilges not even excepted—than all that which tends to the life and to the well-being of that boiler with which they have so much to do when on a voyage.—*The Engineer.*

"WATERWITCH" PUMP.

We took an opportunity lately offered of inspecting various specialities of marine engineering and fittings constructed by Messrs. Blundell & Co., who seem to have adopted this branch as peculiarly their own. Of these we can only at present refer to the new "Waterwitch" Pump, of which we give sketches in elevation and vertical section. This Firm succeeded to the business of Mr. Downton, and as such became makers of the celebrated "Downton" Pumps, which, first introduced in 1825, have held their own so well ever since. The experience thus acquired and laboriously experimented on, resulted in the production, by the Messrs. Blundell, of the "Waterwitch," as in every way the superior of the old-fashioned "Downton." Such has been their success, that the "Waterwitch," size for size, equals in delivery three "Downtons," and this has only lately been confirmed by severe Admiralty tests.

A glance at the vertical section will show that this is effected by the use of four double-acting pistons, there being only two pump rods. We have thus a theoretical efficiency of eight single acting pumps, the "Downton" being equal to three. Thus it follows that a 4-in. "Waterwitch" will do as much work as a 5¾-in. "Downton," the latter costing about double the former. The barrel is used for the pistons only, the valves and passages being outside, thus forming, so to speak, two concentric cylinders. It will be further observed that there are no inside working valves, and no foot valves. The total number of valves is only four (as against seven in the "Downton") and each of these is in a chamber closed externally by a door. The door bolts are hinged to the pump, flying back when the nuts are loosed. The removal of the door removes, at the same time, the valve which is hinged thereto. There is no possibility of anything getting lost. The valves are ordinary leather-faced clacks, which any ordinary workman can manage without fear of doing any damage. The weight of these pumps relatively to their strength and power is very small. The "Waterwitch" is being fitted on all the P. and O. Company's new boats, and on the gunboats of the Royal Navy; and we need only wish it a career as successful as its respected predecessor, the "Downton."

THE "WATERWITCH" PUMP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THE "CROWN EJECTOR" VENTILATOR.

IN our recent account of the Imperial Russian Yacht *Livadia*, we mentioned that it was fitted for purposes of ventilation with Messrs. Sharp & Co.'s "Crown Ejector." There are many valuable ventilators, but this one possesses the unique merit of simplicity—there being not only no nice adjustments, but an absolute absence of moving parts. It consists of a truncated dome, surmounted by a concentric dome-shaped cap. The shaft or flue runs up perfectly straight, and finishes flush with the truncated end of the dome. The action of the wind, from whatever direction or with whatever force it may blow, produces a partial vacuum. The result is an immediate and unerring upward current in the shaft. A down draught is impossible, and there are no crevices or chambers for the accumulation of impurities. The "Crown Ejector" certainly seems to present the acme of simplicity, and so to be well suited for ship ventilation, where these appliances are most wanted just when there is least time to attend to their irregularities.

The "Ejector" can also be made of glass. From the peculiar mode of its construction, and the absence of machinery, revolving vanes, &c., to obstruct the view, it thus serves all the purposes of a sky-light, and establishes an additional claim to the attention of marine engineers.

THE HUSTON SELF-LEVELLING BERTH.

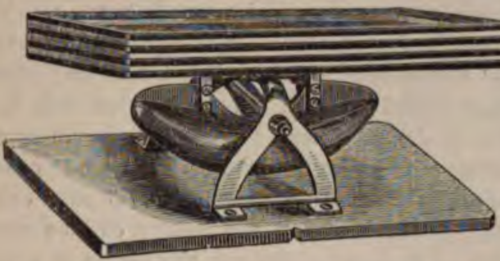
WE do not, for a moment, believe that the Huston Berth Company claim to have discovered an absolute preventive for sea-sickness, that distressing malady which shares with toothache the honour of attacking high and low, rich and poor, weak and strong, with supreme impartiality, impervious alike to the attacks of ridicule and the exertions of scientific investigation. The reason is a perfectly simple one, yet very few unpractical people seem able to realize it. The most complicated motion to which a passenger in a berth can be subjected is resolvable into three, one in a vertical line, and two in the horizontal plane. Leaving the former for a moment, we can compound the latter together, giving the forward motion of the ship and with it the passenger. It is quite impossible to counteract this motion, which would mean that the passenger should be left stationary while the ship moved on and left him behind. In a calm sea the resultant motion is the one, and the forward movement is as easy and, as regards movement in the horizontal plane, identical with, progression in a carriage or railway train. In a rough sea this movement is really a *resultant*, the unfortunate victim's forward motion being the product of innumerable jerks in all directions. It is the object of all contrivances of the class under notice to modify or counteract these jerks, each irregular movement being, so to speak, balanced by another, so that the total effect is nil.

Turning now to the vertical component, we find that it places the passenger in the position of those toys we see attached to elastic strings, that is, bobbing up and down. In other words, the horizontal plane, all unnatural motion in which may have been done away with,—continually moves up and down, carrying with it passenger, berth and all. We do not know that there has ever been so much as a suggestion as to how this vertical motion can be corrected, or even modified. In fact, as the forward motion proper can only be done away with by stopping the ship, so can the vertical motion be abolished only when gravity is abolished with it—and not till then.

Unfortunately it is precisely this vertical motion which is the most potent factor in causing sea sickness. The sudden changes of level produce by well-known hydrostatical laws sudden changes of pressure of the blood on the brain and internal organs, and of the contents of the stomach. Any one liable to sea sickness can test this satisfactorily by spending some time in a small boat riding at anchor in a ground swell.

Though this, however, be an ascertained fact, it is equally undoubted that sea-sickness may, like any other ailment, be seriously aggravated by accessories capable of alleviation and even removal. The patient may be fortified against the attack and enabled to battle with and subdue the enemy. Imagination, the state of the liver and digestive organs, inability to obtain sleep and rest may convert a slight indisposition into a serious illness. Here, such contrivances find their sphere. Where effective they enable the sufferer to rest as quietly as in his own bed, and obtain the repose and quiet so necessary for recovery. This boon is not confined to the victims of *mal de mer*. All who dislike playing the part of shuttlecock between the walls of the cabin, captains and officers in their few hours of repose, ordinary invalids and wounded, will appreciate the benefit. As an instance we may note that this very berth is under consideration by the Admiralty for adoption in the infirmaries of men-of-war.

The Huston berth, which is of American invention, starts on a totally different theory from the appliances that have been from time to time placed before the public. Most, if not all, have consisted of some modification of "swinging," and have failed, either because they would not act at all, or when they did act produced effects so startling as to be much worse than the disease. Space not permitting us to investigate the causes of failure, suffice it to say that the Huston has no swing, but is strictly a *self-levelling* berth. The illustration shows very plainly the simplicity of construction and principle. It is merely an ordinary berth poised at its centre on a universal joint, and regulated in its motion by a crescent-shaped weight which bears a certain proportion to the weight of the human body. India-rubber springs at the corners further control the motion, and the passenger—sea-sick or not—can rest as quietly as in his own bed at home. With the thorough practicalness of the American inventor, Mr. Huston has so designed his berth that it occupies no more space than an ordinary berth, which it perfectly resembles, requires no expensive or complicated setting or adjustment, interferes in no particular with the present sleeping arrangement on board ship, and can be at once, if desired, transformed into a fixed berth.



That the berth performs its promise is sufficiently attested by the certificates of practical men and passengers, who have experience of the 200 now in use on the North German Lloyd's, Havana and Mexican, and other American lines. Copies of these can be obtained from Messrs. W. Nicolson & Co., 5, Jeffreys-square, London, E.C., the English agents, at whose offices also those interested may inspect a full-sized berth which has been fitted up for that purpose.

TORPEDO BOATS.—At Saltonshall Lake two representatives of the Lake Torpedo Company, the manufactory of which is at Hartford, are engaged in experimenting with one of the company's locomotive torpedoes. The casing is a comparatively recent invention, and the object of the experiments is to improve it in a variety of ways. It is made of sheet-iron, is about 25 ft. in length and 18 in. in diameter, and is pointed at both ends. The motive power is a screw propelled by an engine which derives its motion from the generation of gas. The course of the torpedo is directed from the shore or vessel from which it is sent by means of electricity, paying out wire for the transmission of the electricity as it advances. The explosive power is dynamite, of which 125 lb. are used. Torpedoes of this kind have been sold to the Russian Government and to the Peruvian Government, and some are in course of construction for the United States Government. Among other experiments to be tried will be one to submerge the boat and propel it when hidden beneath the water. One of the gentlemen experimenting at Saltonshall Lake, was in Peru some months since explaining the working of the torpedoes, and while there a person unfamiliar with the invention began experimenting with one of them, and as he failed to remove the dynamite, the result was the killing of fourteen men.

VULCANIZED FIBRE.

CONSIDERABLE attention has lately been directed to the use of a new material which claims equality with, if not superiority to, leather, vulcanite, wood and even metals in various situations where these substances are employed. This comprehensive body consists of vegetable fibre reduced to a pulp, and thereafter subjected to powerful chemical treatment whereby the original properties of the fibre are entirely changed and a new material produced. The most prominent characteristics of this are its strength and toughness, permanent elasticity and great durability. It is non-absorbent of oils and liquids, except water, which acts on it precisely as it does on leather. Indeed the flexible variety is used for clacks, washers, and all other purposes where leather is usually employed.

The hard variety somewhat resembles horn in consistency; it cannot be cracked or broken, it works easily and handsomely in a lathe, can be drilled, rivetted, sawn, and stamped, can be fitted with a sharp strong screw head, and takes a beautiful polish.

These qualifications well adapt it for the purpose with which marine engineers are more immediately concerned. It has always been a great trouble to them to keep tight the packings or ferrules around the tubes of surface condensers, so as to prevent leakage, and yet permit the tubes to expand and contract freely through the tube sheets or heads of the condensers. Various substances, as leather, paper, hemp, rubber, lead, and wood have been tried for the purpose, wood having generally been considered most suitable. Vulcanized fibre has been thoroughly and most severely tested in this connection; and vulcanized fibre ferrules have been pronounced to be not only the best, but absolutely perfect in their operation. Such being the case, there ought to be no question as to their ultimate universal adoption.

DOORS AND WINDOWS OF THE EDDYSTONE LIGHTHOUSE.

IT is evident the Trinity House Corporation have determined to make the new Eddystone Lighthouse, an unique specimen of lighthouse building. The greatest forethought and ingenuity has been displayed in the design of every detail, and the most extreme care and supervision exercised in the execution thereof. We had recently the pleasure of inspecting portion of a contract undertaken by Messrs. Blundell Bros., of Limehouse, for the metal doors and door frames, shutters and window-frames for this remarkable edifice.

All these parts are of the most massive and costly description. The patterns alone, which will probably never be required again, would form admirable country house doors and windows. From these the castings are taken of the best gun-metal, within a very small per-centage of pure copper, and when we state that the chief door, by no means a large one, weighs 1¾ tons, our readers can form some idea of the ponderous nature of the contract. Every casting is cast with a test piece, to be cut out in the presence of an official and tested at Woolwich; and it must be gratifying to the firm to know that no single piece has as yet failed to pass the contract breaking strain of 16 tons per square inch. The faces are all planed true and air-tight, while the frames are strengthened at the back by ribs and flanges, by which the whole will be bolted and concreted into the walls. The result is a specimen of finished workmanship, of which any firm would have reason to be proud.

HYDRAULIC STEERING GEAR.

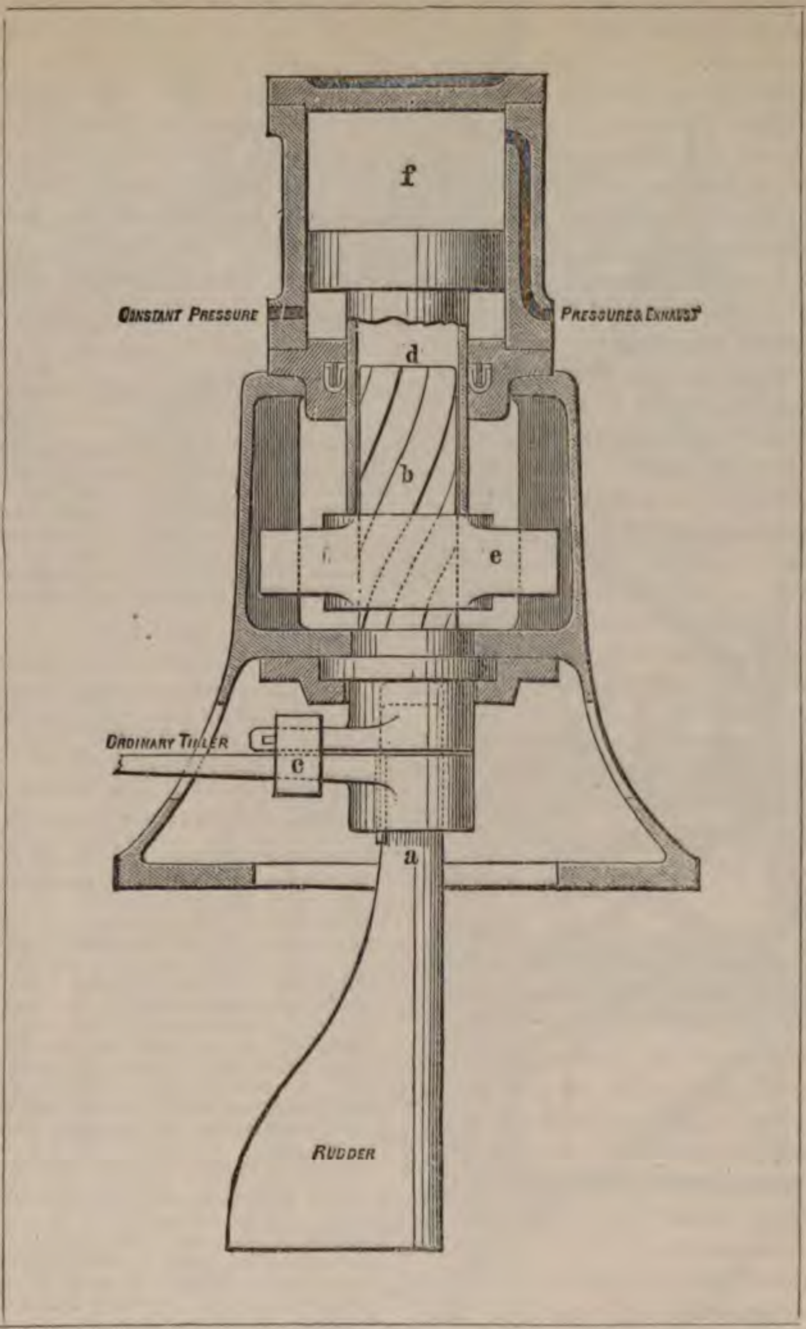
THAT collisions and accidents to vessels are frequent from the failure of the steering gear or its want of promptitude in emergencies may be seen by perusal of the daily papers. A frequent want of promptitude is not surprising when the number of revolutions that the hand wheel has to make to put the rudder hard over is taken into consideration, and the power required even then to operate it. It is not to be expected that even in moderate sized vessels, the single hand usually considered sufficient at the wheel can act with the necessary power and promptitude in the case of sudden emergency. In the case of the finest liners, and in that also of our ironclad navy, hand steering is now considered very generally to be quite inefficient, and the only difficulty now is to determine the best mechanical apparatus to effect the purpose. Steam steering gear is by no means in all cases fulfilling the expectations formed for it, as the connecting gear is apt to get out of order. The cases of the *Téméraire* and *Independencia* some few years ago, are instances of the failure of steam steering gear. We think, however, that Lafargne's Hydraulic Steering Gear, which we illustrate herewith deserves special attention from ship owners as promising a mechanical steering gear of enormous power, very speedy, and with no parts likely to get out of order. This gear is in the hands of Messrs. Lloyd, Lowe & Co., of 7, East India Avenue, to whom we are indebted for the following particulars. The rudder is operated by hydraulic pressure, conveniently of 700 lb. per sq. in., thus giving enormous power in a much less space than that in which steam of 50-lb. per sq. in. could operate to effect the same work. This water pressure is generated in a special arrangement of force pumps fixed in the engine-room, and which are so self-acting as to require no accumulator, supplying the water as required. The high pressure water is led to the steering gear, which is directly over the rudder head, by the means of suitable pipes, and branching from a suitable cock or valve communicates with both the top and bottom of the cylinder, *f*, by the ports marked "constant pressure," and "pressure and exhaust." The piston in the cylinder has a hollow trunk or rod, *d*, which, passing through an hydraulic cup-leather as packing, is attached to a sliding cross-head, *e*. This cross-head is cut with an internal thread, and thus acts as a nut on the shaft, *l*, which is cut with long pitched threads or fluted spirals. The shaft or bolt, *b*, fits over the rudder head, and is attached by an arm to the ordinary tiller by a slip ring, *c*. In case of possible accident to the steering gear, this slip ring can be immediately removed and the rudder can be worked by hand. The water acts upon the piston in a differential manner The pressure is always maintained on the under side of the piston, but as it is much smaller in area (apparently about half) than the upper surface, when pressure is submitted above, the piston is forced down. When the exhaust from the upper part is opened, the pressure underneath forces up the piston, discharging the waste water. This reciprocating motion communicates, by means of the spiral threads, the requisite angular motion to the rudder. Owing to there being always water above and below the piston, and the constant pressure keeping it home on the exhaust stroke, there is no possibility of jerk on the pistons.

Relief valves are applied to the cylinder, so as to allow a certain freedom of motion to the piston under sudden blows from a heavy sea. One man can manage it in all weathers without danger to himself, and the rudder can be brought round to port or starboard in less than five seconds.

The apparatus is now in daily use on the Thames, and we have before us a very satisfactory testimonial from Mr. John J. Ney, of the Thames and Channel Passenger Service, as to the admirable working of this gear; so it must no longer be considered as experimental in character, but approved in actual work.

ON the 1st September Messrs. John Elder & Co. laid the keel of second large steamer for the Guion Line, to be named the *Alaska*. She is to be constructed on somewhat similar lines to the *Arizona* but is to be of much larger dimensions, viz., 500 ft. long 50 ft. broad, and 40 ft. deep, with a tonnage of close upon 7,000, and to be driven by engines to indicate 10,000-horse power.

HYDRAULIC STEERING GEAR.



THE PULSOMETER AS A SALVAGE PUMP.

A MOST important operation, that is daily receiving more and more extended application, is the raising of sunken vessels. This should prove a most remunerative form of salvage. Many millions of money are annually sunk, in situations from which engineering skill ought to be able to rescue it, in the shape of vessels sunk, often with valuable cargo on board, in comparatively shallow water. Under those circumstances, in which the vessel is entirely submerged to some little depth, the raising has hitherto baffled the skill of our most enterprising engineers, but the Pulsometer Engineering Company, have lately shown what can be done in the raising of the steam-ship *Tyne*, which we herewith illustrate.

This vessel formerly belonged to the Royal Mail Steam Packet Company, but had been sold by them, and was in process of demolition, when a storm arising she filled with water, and sank in the Itchen

River, at Southampton. She lay upon a shoal with her back very much strained or partly broken, and was partly uncovered at low water, but entirely covered to some depth when the tide rose. There was only about an hour between the period of extreme low water and the height of tide, at which the water began to pour in through her port holes and broken upper works. It was necessary then, in this hour to pump out all, or at least sufficient of the water contained in her hull to make her float as the tide should rise. It was thus necessary that all the pumping apparatus should be fixed ready for work in the course of the low tide, previous to that in which pumping was to be commenced. The whole pumping apparatus would thus be under water during the period of high tide. A further difficulty to the fixing of ordinary pumps was that the decks had been all removed, and there was nothing to which machinery could have been fixed. The Pulsometer Engineering Company, however, undertook the contract to remove the water in the period of low tide, so as to cause the ship to rise with the returning tide. In order to strengthen the vessel when she should rise from the sand-bank, a strong 8-inch steel wire hawser was connected, as shown, to the stem and stern, and run over a strong upright timber frame in the centre of the vessel. This thoroughly stiffened her frame, and was amply sufficient for the Pulsometer Company to attach their pumps to. Four of the No. 9 Pulsometers may be observed hanging like so many gigantic bats, from the longitudinal steel hawsers.

The construction of these pumps we have already described, and it will be remembered that they consist of two working chambers uniting in one neck, through which the steam is admitted alternately to each chamber, where it acts direct on the surface of the water in the chambers, ejecting it as in an ordinary pump. A period of condensation ensues when the steam has depressed the water in the working chamber to the level of its egress at the lower part of the chamber, which vacuum causes the oscillating steam ball valve to close the steam admission, and thus obliges fresh water from the suction pipe to enter and fill the vacuum, to be afterwards again ejected. The Pulsometer is thus without any piston or working parts except the large flap valves. Any sand, sediment, or debris, can thus pass freely through the pump without injury, and there is no working part exposed that could be injured by immersion in salt water. This pump, when fixed as shown, was connected by flexible pipes to the boiler of the steam-tug *Sovereign* moored alongside, and pumping was commenced energetically by all four Pulsometers between four and five o'clock in the morning, when the state of the tide served. These pumps discharged the enormous amount of 700 tons of water in forty-five minutes, so that as the tide returned the wreck rose with it, and by the aid of three steam-tugs was safely conveyed across the river into the graving dock, just as she had been raised, as shown in our engraving.

The facility with which these pumps can be worked entirely suspended, renders them especially suitable to all tidal operations, as the connections may be so easily made by flexible tubing, and the height of the Pulsometer thus adjusted to suit the height of the water.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

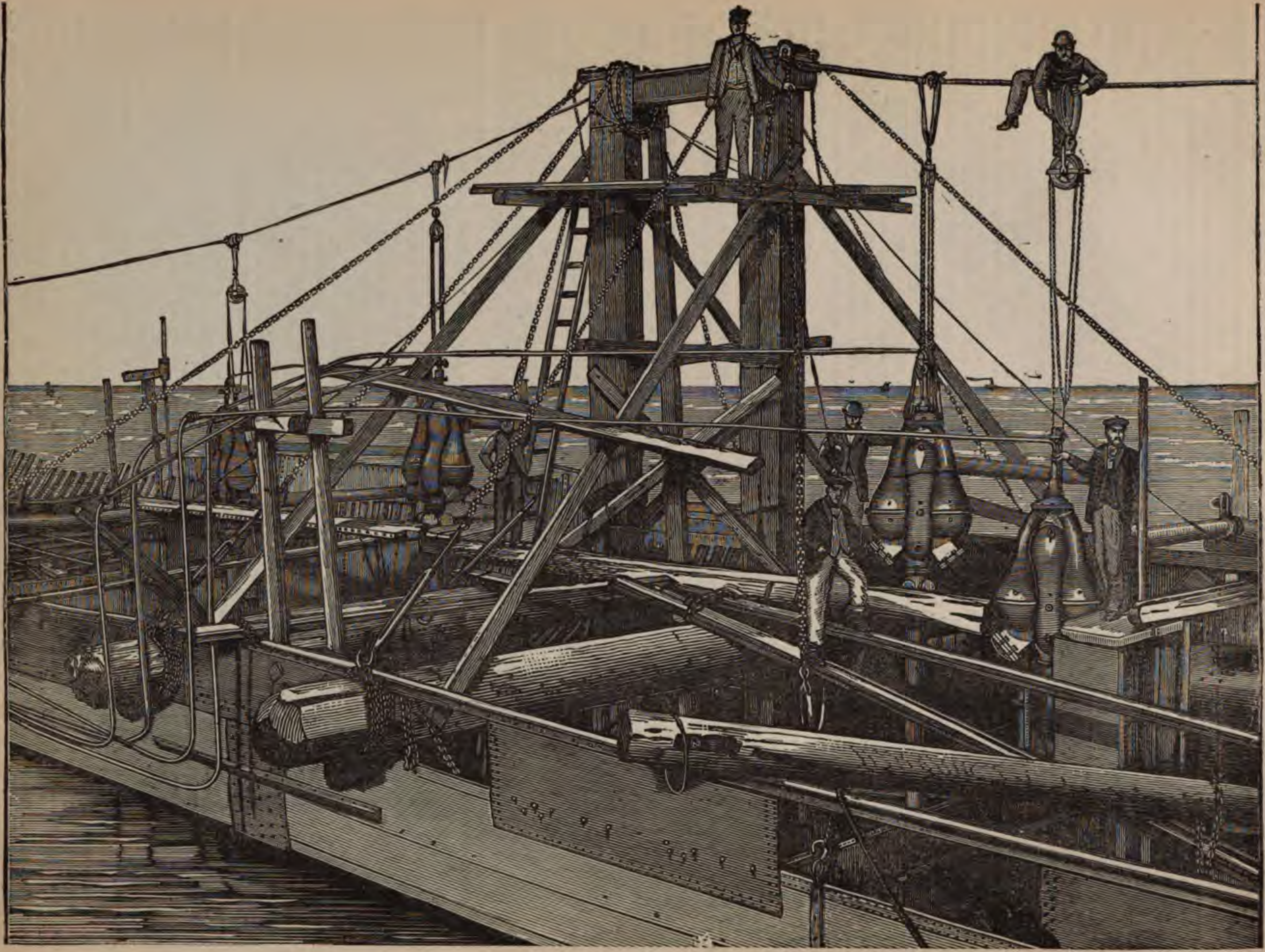
LAUNCHES.—ENGLISH.

Vivienne.—On Monday afternoon, the 20th inst., an iron screw steamer was launched from the building-yard of Messrs. Richardson, Duck & Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length over all, 248 ft.; length between perpendiculars, 240 ft.; breadth, extreme, 34 ft.; depth in hold, 16 ft. 6 in.; depth, moulded, 17 ft. 5 in.; tonnage, o.m., 1350 tons; gross, n.m., about 1313 tons; carrying capacity, about 1700 tons. She is classed 100 A1 at Lloyd's, and has been built under special survey. She has a long quarter deck extending to engine room, a bridge over engine and boiler spaces, with part of it fitted up for the accommodation of engineers and second and third officers, and a topgallant forecastle for the use of the crew. The saloon and captain's accommodation is under the quarter deck aft, and is reached by an iron companion from the deck. The after steering gear is protected by an iron house. Her engines are on the compound direct-acting principle, built by Messrs. Blair & Co., Limited, of Stockton-on-Tees, and are of 120-horse power, with cylinders of 30 in. and 55 in. diameter, the length of stroke being 36 in., with a working pressure of 80 lbs. The vessel has been built to the order of John Cuthbert, Esq., of Cardiff, and under the superintendence of Mr. Norman, of that firm. As the vessel was leaving the ways she was gracefully christened the *Vivienne* by Mrs. Norman.

Propitious.—On the 3rd September the steamer *Propitious* was launched from the yard of Messrs. Short Bros., Pallion, Sunderland. The vessel has been built to the order of Messrs. Taylor & Sanderson, Sunderland. She is 270 ft. in length; breadth, 37 ft., and 18 ft. 6 in. depth of hold, with a deadweight carrying capacity of 2,650 tons, and is fitted with the most improved machinery, including Emerson, Walker & Co.'s Patent Combination Windlass.

Annie.—On the 4th September Messrs. C. S. Swan & Hunter, Wallsend, launched an iron screw steamer, 200 ft. long, by 28 ft. 6 in. broad, and 15 ft. 6 in. deep, built to the order of Mr. Theodore Rodmasker, Dantzic, and Messrs. Bremer, Bennett, & Bremer, London. The vessel will have engines by Messrs. Black, Hawthorn, & Co. She is intended for the grain trade between the Baltic and London. She was named the *Annie* by Miss Bennett, of London.

James Grice.—On the 4th September there was launched by Mr. James Laing, Sunderland, a steamer named the *James Grice*, built for Messrs. Jones Brothers & Co., of Newport (Mon.). to class 100 A1. Her dimensions are:—250 by 34 by 18½ ft., with a full poop and forecastle and long hurricane-house, giving exceptionally good protection for the Atlantic trade. She will have all the most modern equipments, and will be fitted with a pair of engines of



150-horse power, in the well-known style of the North Eastern Marine Engineering Company. On leaving the ways she was named by Mrs. M. M. Jones, of Maindee Hall.

Hilda.—On the 4th September, Messrs. W. Gray & Co., of West Hartlepool, launched from their yard a screw-steamer, built to the order of Messrs. F. Herskind & Co., of the same town. Her dimensions are:—Length between perpendiculars, 256 ft. 6 in.; breadth, 34 ft. 6 in.; and depth of holds, 19 ft. 8 in. and 24 ft. Classed 100 A 1 at Lloyd's. Engines 150 horse-power, by Messrs. T. Richardson & Son, of Hartlepool. Gross tonnage, 1,750 tons. Will carry a deadweight of 2,350 tons. As she left the ways she was christened the *Hilda* by Mrs. Fritz Herskind, of Seaton Carew. The new steamer will be commanded by Captain B. B. Murrell, late of the *Palma*.

Keroula.—On the 6th September there was launched from the Wear Shipbuilding and Dockyard, Sunderland, by Messrs. S. P. Austin & Son, an iron screw steamer of the following dimensions:—Length between perpendiculars, 260 ft.; breadth, extreme, 35 ft. 6 in.; depth of hold, 18 ft. 6 in., with long half-poop, short full poop for captain and officers, bridge-house, and topgallant forecastle; to class 100 A 1 at Lloyd's. Her engines are compound surface-condensing, and her boilers will be fitted by Mr. G. Clark, of Southwick. She is fitted with a patent windlass, four steam winches, donkey boiler, double bottom for water ballast, on the girder and bracket principle; iron decks, iron lower masts, and all the latest improvements. She has been built to the order of Messrs. Porteous & Senier, of London, for the Atlantic and general trades. As she left the ways she was named the *Keroula* by Miss Hall. She has been specially built to carry a large cargo with a light draught of water.

Swordsman.—On the 6th September, Messrs. T. & W. Smith launched from their yard, Milburn-place, North Shields, a screw steamer, built to the order of Messrs. W. J. Jobling & Co., Newcastle. As the vessel left the ways she was christened the *Swordsman* by Miss Thorpe, of Newcastle. The *Swordsman's* measurements are 250 ft. long, 32 ft. beam, and 16 ft. depth, and her register is 1,000 tons gross. She has been built 100 A Lloyd's, and is destined for the Baltic trade. She will have three steam winches and other apparatus for quick loading and despatch. There will be a long raised quarter deck, and topgallant forecastle for the crew. She will have bridge-steering gear, but not steam. The engines will be 100-horse power, by Hawthorn, Black & Co., Gateshead.

Fournel.—On September 7th there was launched by Messrs. A. & J. Inglis, Pointhouse, a screw steamer for the Compagnie Générale Transatlantique of Paris, the principal dimensions being 300 ft. by 36 ft. by 26 ft., fitted with double bottom for water ballast. On leaving the ways the vessel was named *Fournel* by Miss Nettie Inglis. This is the fifth steamer the Messrs. Inglis have built for this company, and the third launched for them since the 25th March last.

Landore.—On the 7th September an iron screw steamer was launched by Messrs. Schlesinge, Davis & Co., from their ironship yard at Wallsend. This vessel is named the *Landore*, and has been built to the order of Messrs. Poingdestre & Mesnier, of Swansea and Paris. The leading dimensions of the *Landore* are:—Length between perpendiculars, 253 ft.; breadth moulded, 32 ft. 6 in.; and depth moulded, 20 ft. 1 in. The vessel has been built under special survey to take Lloyd's highest class. She has a long half-poop covering the engines and boilers, which are amidships, and the cabins for both passengers and officers are also near the centre of the ship. The chart, companion, and wheel houses are all of iron, and circular in shape. A patent windlass, worked by steam, is fitted; also steam steering gear amidships, and screw gear aft. The engines, by Messrs. R. & W. Hawthorn, of Newcastle, have cylinders 30 in. and 58 in. diameter, with a stroke of 36 in.

Craigmore.—The Barrow Shipbuilding Company have launched from their yard a steamer of about 2,000 tons burthen, built by them to the order of Messrs. W. Johnston & Co., of Liverpool and Barrow, and intended for the Danube trade. She was named *Craigmore* by Mrs. Frank Shleman, of Barrow. The new steamer is 260 ft. in length, 34 ft. in breadth, and 18 ft. depth of hold.

Borodino.—On the 16th September Earle's Shipbuilding and Engineering Company (Limited), Hull, launched from their yard a steel screw steamer for the Baltic trade of Messrs. Thos. Wilson, Sons & Co. The vessel was named *Borodino* by Miss Nessie Goode, of London. The principal dimensions of the *Borodino* are:—Length between perpendiculars, 240 ft.; breadth extreme, 23 ft.; depth of hold to top of inner bottom, 17 ft. 3 in. She has been constructed on the cellular bottom principal, and classed for 20 years in the Liverpool Underwriters' Registry. She will be propelled by engines of 120 nominal-horse power, which also have been constructed by Earl's Company, and she is expected to attain a speed of 9½ to 10 knots at sea. This vessel is generally similar to the *Silvio* and *Gitano*, which were recently constructed by Earls's Company for Messrs. Thomas Wilson, Sons, & Co. She is the 57th vessel this company have built for these Owners, who have also three other steamers under construction at the same yard.

Amity.—On September 16th an iron screw steamer, built to the order of Robert H. Gayner, Esq., Sunderland, was launched from the shipbuilding yard of Mr. Robert Thompson, jun., Southwick, Sunderland. Her dimensions are:—225 ft. long by 32 ft. 1 in. broad, and 17 ft. 11 in. depth of hold, and she has been constructed under Lloyd's special survey to class 100 A 1, and the personal superintendence of Captain Kinmond. She is to be fitted with engines of 120-horse power by the North-Eastern Marine Engineering Company (Limited), of Sunderland, being on the inverted direct-acting compound surface-condensing principle. The vessel has a covered-in house from side to side over the engine-house, containing cabin for Captain, and accommodation close to engine-room for Officers and Engineers, also for Sailors and Firemen in forecastle. She has been fitted throughout with all the latest improvements, including ample water ballast; three steam winches and donkey boiler, by Messrs. R. Roger & Co., of Stockton; patent steering apparatus on fore part of chart-house, and ordinary gear aft; also Harfield's patent windlass, &c., &c. As the vessel left the ways she was christened the *Amity*, by Miss J. M. Gayner.

Ville de Cette.—On the 20th September there was launched from the shipbuilding yard of Messrs. Hodgson & Soulsby, Blyth, an iron screw steamer of the following dimensions:—Length 220 ft.; breadth, 31 ft.; depth of hold, 18½ ft. The steamer is fitted with two iron decks, full-length cabin aft for 14 first-class passengers, and long bridge for officers and engineers, and topgallant forecastle for crew. Her carrying capacity is estimated at 1,400 tons, and she is classed 100 A 1 at Lloyd's, having been built under special survey, and under the inspection of Lloyd's surveyor. The steamer is intended for the wine trade between Cette and Spain, and will be fitted with engines of 130-horse power by Messrs. Black, Hawthorn & Co., of Gateshead. The vessel was named by Miss Kate Hodgson, daughter of one of the builders, *Ville de Cette*. The vessel has been built to the order of a French firm.

Laura Emma.—On September 20th Messrs. John Cowl & Sons launched from their building-yard at Padstow a 12 years A 1 class at Lloyd's schooner, about 200 tons burthen, named the *Laura Emma*. This vessel is owned by Captain William Philip & Co., of Padstow, and is intended for both the foreign and coasting trades. The ceremony of christening was performed by the Hon. Mrs. Prideaux-Brune.

Pearl.—On the 21st September there was launched from the yard of Mr. William Thomas, shipbuilder, Amlwch, a schooner called the *Pearl*, of about 220 tons burthen. She was taken to the dry dock to fit out. The ceremony of naming the *Pearl* was performed by Miss Evans, daughter of the principal owner.

Wigtonshire.—On the 21st September Messrs. Russell & Co. launched an iron sailing vessel, for Messrs. Thomas Law & Co., Glasgow, of the following dimensions:—Length, 194 ft.; breadth, 32 ft. 6 in.; depth of hold, 19 ft. 7 in.; of 900 tons register, and with a capacity to carry 1,470 tons dead weight. The ceremony of naming the new vessel the *Wigtonshire* was performed by Miss Helen Henderson, of Glenvale. The *Wigtonshire* will be another addition to the line of clipper packets to Australia and New Zealand, and is built after the model of the *Peebleshire*. The *Wigtonshire* is classed 103 A 1 at Lloyd's, and makes the third vessel built this year for the firm. After fitting up, she will proceed to Glasgow to load for Wellington (N.Z.).

Benefactor.—On the 22nd September Messrs. W. H. Potter & Son launched at Liverpool a screw steamer of about 1,400 tons, named the *Benefactor*, built to the order of Mr. Joseph Hoult, of Liverpool, for his Spanish and West Indian trades. As the steamer left the ways, the ceremony of christening was performed by Miss Fowler, daughter of Mr. William Fowler, one of the owners.

La Barrouere.—On September 22nd a new screw steamer, built to the order of Messrs. Morel Brothers, Cardiff, was launched from Polmer's yard, Jarrow. The vessel, which is a sister ship to the *Beignton*, built for the same firm a short time ago, is 240 ft. long, 33 ft. broad, and 17 ft. deep. She will be fitted with a pair of Palmer's engines, of 99-horse power nominal. She will have water ballast fore and aft, and all the latest improvements. The carrying capacity of the vessel will be over 1,800 tons deadweight. As the ship left the ways she was christened *La Barrouere* by Miss D. Armstrong, daughter of Mr. Armstrong, manager of the shipyard department at Jarrow. The steamer is intended for the Bilbao trade.

Emmy Haase.—On the 23rd September there was launched at the shipbuilding-yard of Messrs. Joseph Thompson & Sons, North Sands, Sunderland, an iron screw steamer, built to the order of Messrs. Johnasson & Wiener, Messrs. Gordon & Stamp being the Managing Owners. The ceremony of naming the vessel *Emmy Haase* was performed by Mrs. Wiener, of The Elms, wife of Mr. Martin Wiener, of Sunderland. The vessel is of the following dimensions:—Length, 260 ft.; breadth, 36 ft.; depth, 18 ft. 3 in., with a deadweight carrying capacity of 2,000 tons. She is constructed under special survey, and is of the highest classification at Lloyd's, viz., 100 A 1. The engines, which are of the compound surface condensing principle, and of 160-horse power nominal, are being fitted by the North-Eastern Marine Engineering Company. The ship and engines will be fitted with the most modern improvements for the economical working of the vessel.

Bellini.—On the 23rd September there was launched from the iron shipbuilding yard of Messrs. Short Brothers, at Pallion, Sunderland, a screw steamer, to the order of Messrs. Jenneson Taylor & Co., of Sunderland, of the following dimensions and particulars:—Length, 260 ft.; breadth, 36 ft., and 19 ft. 9 in. depth of hold, with a deadweight carrying capacity of about 2,350 tons. She is classed 100 A 1 at Lloyd's under special survey, and is constructed on the cellular bottom principle, divided into compartments for trimming. She has a short full poop for the accommodation of captain and officers; long raised quarter-deck extending to bridge-house, which encloses engine and boiler spaces, and a top-gallant forecastle, the latter being fitted up for the acccommodation of crew in separate compartments. The accommodation for engineers is in a large house on the quarter-deck. The vessel has four large hatchways, with a steam winch at each, by Clark, Chapman & Gurney, of Gateshead, Harfield's latest patent steam windlass, and Bow, Maclachlans & Co.'s patent steam steering gear. On leaving the ways the vessel was named the *Bellini*, the ceremony of christening being performed by Miss Ada May Short, of the Elms, Sunderland, daughter of the builder. The vessel is to be fitted with engines and boilers of 180-horse power, by Mr. John Dickinson, of Monkwearmouth, with all the latest improvements in engineering.

Solon.—On the 18th September, Messrs. Turnbull & Sons launched from their shipbuilding-yard, Whitby, an iron screw steamer of the following dimensions:—Length, 240 ft.; breadth, 34 ft.; depth, 17 ft. 9 in.; having a deadweight carrying capacity of about 1,950 tons. Her engines, of 120-horse power, are by Blair & Co., Stockton-on-Tees. She is built to the order of Messrs. Robinson & Rowland, of Whitby. As she left the ways the vessel was christened the *Solon* by Miss Robinson, daughter of one of the Managing Owners.

Oaklands.—On the 18th September, there was launched at West Hartlepool, from the yard of Messrs. Wm. Gray & Co., a steamer built to the order of Messrs. Hardy, Wilson, & Co., of West Hartlepool. The dimensions of the new steamship are:—Length between perpendiculars, 228 ft.; breadth, 30 ft.; and depth of holds, 16 ft. 9 in. and 20 ft. 9 in.; gross tonnage, 1,114 tons; will carry a deadweight of 1,400 tons on a light draught. As she left the ways the new vessel received the name of the *Oaklands* from Mrs. Wilson, of Seaton Carew.

Flaminian.—On the 18th September there was launched from the yard of Palmer's Shipbuilding and Iron Company (Limited), Jarrow, an iron screw steamer, named the *Flaminian*, and built for Messrs. Leyland and Co., Liverpool. The steamship is a sister vessel to the *Flavian*, built by the same firm a short while ago for Messrs. Leyland, and is specially designed for the carriage of valuable cargoes of produce, &c., between America and the United Kingdom. The dimensions of the *Flaminian* are:—Length, 340 ft.; breadth, 33 ft. 3 in.; and depth of hold, 24 ft. Her carrying capacity is 2,900 tons deadweight, and she is classed 20 years Liverpool register. The ceremony of naming the *Flaminian* as she left the ways was performed by Mrs. Price, wife of Mr. John Price, general manager of the Palmer Company.

Limosa.—On the 20th September, Messrs. M. Pearse & Co. launched from their iron shipbuilding premises at Stockton-on-Tees, an iron screw steamer of the following dimensions:—Length between perpendiculars, 250 ft.; breadth moulded, 33 ft. 6 in.; depth to keel, 24 ft. 10 in. This vessel is about 1,620 tons gross register, and will carry 2,300 tons deadweight cargo and fuel. She has been built under special survey, and of the highest class at Lloyd's off the three decked rule, the main deck being of iron. She is flush-decked, with long bridge house, chart-house amidships, short full poop aft, topgallant forecastle for crew. Accommodation will be provided in the bridge-house for engineers, &c., and in the poop for captain and officers. Her engines, by Messrs. Blair & Co. (Limited), are of 140-horse power nominal. She is fitted with double bottom for water ballast. She has four double cylinder horizontal steam winches, and all necessary and improved appliances for quick loading and delivery. She is built for Messrs. Porteus & Senior, of London, and on being launched she recieved the name of *Limosa*, the christening ceremony being performed by Miss Todd.

Pakhoi.—On September 20th Messrs. Scott & Co., shipbuilders, launched from their shipbuilding-yard at Cartsdyke a screw steamer of the following dimensions:—Length, 250 ft.; breadth, 31 ft.; depth, 24 ft. 3 in.; and 1,400 tons burden. She has been built to the order of Messrs. John Swire & Sons, London, and will be engined by the builders. Like her sister steamer, the *Hoihow*, the boilers are fitted with Fox's patent corrugated furnaces, by the Leeds Forge Company. As the steamer left the ways she was named the *Pakhoi*. After the launch, the vessel was towed down to the East India Harbour, where she will have her machinery put on board and made ready for sea. The *Pakhoi* is intended for the China coasting trade.

LAUNCHES.—SCOTCH.

Petrel.—Messrs. Barclay, Curle & Co., launched from their yard at Whiteinch, on the 23rd August an iron screw steamer, named the *Petrel*, for the Glasgow and Greenock Shipping Company's carrying trade. The new steamer is 112 ft. in length, 20¼ ft. in breadth, and 9½ ft. in depth. Her engines are on the compound principle, and are of 40-horse power.

Olderfleet.—On the 23rd August there was launched from the shipbuilding yard of Messrs. T. B. Seath & Co., Rutherglen, a fine iron screw steamer, which has been built to the order of Mr. Hugh Smylie, of Paisley and Carlough. Her dimensions are 125 ft. by 21 ft. by 10 ft., is of the highest class at Lloyd's, and has a gross tonnage of 210. The *Olderfleet* will proceed to Anderston Quay, Glasgow, where she will be fitted with a pair of compound surface condensing engines of 50 h.p. nominal.

Franklin.—Messrs. David and William Henderson & Co., launched on the 23rd August from their Meadowside Works, Patrick, a screw steamer of the following dimensions:—Length, 200 ft.; breadth, 26 ft. 6 in.; depth of hold, 19 ft. 3 in.; gross tonnage, 730. She is an awning-decked vessel, built to highest class at Lloyd's for the Spencer's Gulf Steamship Company, of Adelaide, having been specially designed to meet the requirements of their inter-colonial trade. The vesssel was named *Franklin* by Miss Bradbury, Shortlands, Kent. The *Franklin* has accommodation for about 50 first-class and the same number of second-class passengers, and will be furnished with compound surface-condensing engines. On completion she will proceed direct to Adelaide under steam.

Dunbeath Castle.—The Campbeltown Shipbuilding Company successfully launched from their yard at Trench Point, on the 23rd August, a finely-modelled screw steamer of 220 tons, to the order of Messrs. Henderson & Co., distillers, &c., Wick. As the vessel left the ways she was named the *Dunbeath Castle* by Mrs. M'Kay, wife of Captain M'Kay, of Wick. The vessel is intended for the continental fish and grain trade.

Diana.—On September 4th Messrs. W. Denny & Brothers launched from their shipbuilding-yard at Dumbarton a steel saloon paddle steamer, of the following builder's dimensions:—160 by 26 by 9 ft.; gross tonnage about 560 tons. She has been built for the Lloyd's Argentine de Navagacion á Vapor Coy, and is intended for passenger service in South America. This company has been formed in London with a view of developing the traffic of the River Plate. The vessel on leaving the ways was named *Diana* by Miss L. A. Denny, of Meadowbank, Dumbarton. The engines, which will be supplied by Messrs. Denny & Co., are of 600-h.p. effective. It is the intention of the company further to develop this traffic by placing some steamers in connection with the Buenos Ayres and Campana Railway, and also in connection with the Tucuman and Cordobo Railway.

Sea Queen.—On the 4th September Messrs. D. Allan & Co., Shipbuilders, Leith, launched from their yard a screw steamer named *Sea Queen*, of the following dimensions :—Length, 90 ft, ; breadth of beam, 16 ft. 4 in. ; depth of hold, 8 ft. 4 in.

Lyra.—On the 4th September there was launched from the yard of Messrs. J. and J. Hay, Canal Bank, Kirkintilloch, a steam lighter of over 100 tons. As the vessel slipped away from the blocks she was named the *Lyra*, of Kirkintilloch, by Miss Susan Stewart Hillhead. Her machinery is to be supplied by Messrs. Hutson & Corbett, Kelvinhaugh, whence she will proceed forthwith, and when completed will be employed by the Messrs. Hay in the traffic carried on by them on the Forth and Clyde Canal.

Blair Athol.—On the 6th September Messrs. Cunliffe & Dunlop launched from Inch Works, Port Glasgow, an iron screw steamer of about 2,000 tons burthen, built to the order of Messrs. William Johnston & Co., of Liverpool, for their general carrying trade in the Mediterranean or Atlantic, besides being specially adapted for the transport of live stock. She is fitted with steam winches and Emerson, Walker & Co.'s patent brass cone brake windlass. After the launch the vessel was brought alongside the builder's wharf, where the engines, which are of 250 nominal horse power, will be fitted on board, and the vessel completed, ready for sea, preparatory to being handed over to her owners. The ceremony of naming her the *Blair Athol* was performed by Miss A. Kosack, of Ellerslie, Kircudbrightshire.

State of Nebraska.—On the 6th September the London and Glasgow Engineering and Iron Shipbuilding Company launched from their yard at Govan another addition to the fleet of steamers carrying the flag of the State Line for service between this country and America. The ceremony of naming the vessel the *State of Nebraska* was performed by Miss R. Stewart. The new vessel, the *State of Nebraska*, is the first of a "new departure" in several respects from the class of vessels hitherto built for the same company, her breadth of beam being much in excess of any carrying the company's flag. She is 385 ft. long, 43 ft. broad, 34 ft. deep, with a gross tonnage of fully 4,100 tons. She has three decks, and is classed 100 A 1 at Lloyd's. The engines are to be of the compound surface condensing class, and are being constructed to indicate 3,500-horse power. She will accommodate 90 first, 70 second, and 300 third class passengers, for whom every provision has been made. The grand dining saloon, state-rooms, &c., will be most commodious, and the ship will have a promenade deck 125 ft. long, extending over the entire breadth of the vessel. The *State of Nebraska* will be fitted with Messrs. Bow & M'Lachlan's steam steering gear and winches, Messrs. Napier Bros. patent screw appliances, Lindsay's patent contrivance for bringing the furnace ashes to the ship's side, Murdoch's stop and governor valves, and Weir's patent feed heaters and air extractors for boilers.

Filipino.—On September 7th Mr. Robert Chambers, jun., launched from his building-yard at Dumbarton the *Filipino* (s). a vessel of 400 tons burthen, built to the order of Messrs. Olana, Larrinaga & Co., Liverpool. The *Filipino* is the first of two sister ships building in this yard for trading among the Philippine Islands. She will be schooner-rigged, with decks of teak, awning deck amidships, and canvas awnings fore and aft. The engines, compound surface-condensing, of 350-horse power indicated, are being constructed by Messrs. Matthew Paul & Co., and the vessels are expected to attain considerable speed. On leaving the ways, the ship was named by Miss Paul, daughter of Andrew Paul, Esq., Kirktonhill.

Deak.—On the 7th of September, at Greenock, Messrs. Blackwood & Gordon launched a screw-steamer, named the *Deak*, of the following dimensions :—Length, 245 ft. ; breadth of beam, 42½ ft. ; depth of hold, 17¼ ft. ; and of 1,800 tons. The engines, to be supplied by the builders, will be 150-horse power. The *Deak* has been built for the Adria Steam Shipping Company, of which Messrs. Burrill & Son, Glasgow, are managing owners.

Benalder.—On the 8th September, Messrs. Alexander Stephen & Sons launched, at Linthouse, Govan, an iron screw steamer of about 2,100 tons, built under special survey to class 100 A 1 in Lloyd's, and fitted before launching, with compound surface-condensing engines of 240-horse power nominal. This vessel has been built to the order of Messrs. William Thomson & Co., of Leith, for their Ben Line of China steamers, and was named the *Benalder* by Mrs. James W. Thomson, wife of one of the owners.

Persian Monarch.—On the 8th September, this fine vessel was launched at Dumbarton from the yard of Messrs. Archibald, M'Millan & Son. She is one of three similar steamers under construction by the same firm for the Royal Exchange Shipping Company, of London, to form one of the new "Monarch Line" between London and New York. The principal dimensions are :—Length, 370 ft. ; breadth, 43 ft. ; depth to keel, 35 ft. 9 in. ; gross tonnage, 4,000 tons, and tonnage displacement, 7,520 tons. The engines are compound double cylinder, of 2,500-horse power effective. The vessel has a continuous double botton, and seven water-tight bulkheads, giving additional security in case of stranding or collision. Her holds are fitted with permanent iron bulkheads, thus enabling her to carry loose grain with safety. There is also a compartment fitted up for carrying fresh meat. To meet the requirements for the transport of cattle across the Atlantic, a shelter-deck has been constructed over the main-deck, and so arranged that whilst the cattle are protected against heavy weather, a current of air is secured by a system of iron grating ventilators supplemented by a fan-blast. The *Persian Monarch* attains the highest class in Lloyd's and the Bureau Veritas, is adapted for emigrants, and has been built in accordance with the Admiralty regulations to rank on their list as an efficient troopship or cruiser. On the second deck on each side are placed two large gangway ports, well adapted for loading and discharging purposes, and from which a heavy gun can be worked, the crew being under cover. The *Persian Monarch* is capable of carrying coal sufficient to enable her to steam an average speed of 12 knots for four months continuously. She has four masts and the amount of canvas available is such that in an emergency the vessel would be safely navigated by sail alone. The saloon and cabin and officers' accommodation are all amidships. The christening ceremony was performed by Miss Ethel, daughter of Mr. Howard Colls, of Denmark Hill.

Yacht.—Mr. Robert Chalmers, jun., Shipbuilder, Lower Woodward, Dumbarton, launched a beautiful yacht to the order of Mr. J. W. Woodall, Mayor of Scarborough. She is classed 100 A 1 at Lloyd's, and is of the following dimensions :—Length 97 ft. ; breadth, 15·3 by 10·3. The hold is fitted with compound engines by Messrs. Plenty & Sons, Newbury.

Loch Rannoch.—On September 21st Messrs. Gourlay Brothers, Dundee, launched a steel screw-steamer for the Loch Line Company, of which Messrs. Ireland, Leitch & Co. are managers. Miss Pirie, daughter of Dr. Pirie, performed the christening ceremony, the vessel being named the *Loch Rannoch*. Her dimensions are :—Length, 250 ft. ; breadth, 34 ft. ; depth in hold, 23 ft. 8 in. ; gross tonnage, 1530, net about 1000. The *Loch Rannoch* is the sixth steamer built by the Messrs. Gourlay for the same owners. She is classed 20 years in red, being the highest class in the Liverpool Registry. The engines are of 185-horse power nominal, and the cylinders of the engines are 30 in. and 58 in., and 4 ft. stroke. Steam is supplied by two boilers constructed entirely of steel, and having a working pressure of 95 lbs. to the square inch. Captain Lee will have the command of the steamer, which has been built on the longitudinal and bracket system, with inner bottom from end to end. Forward there is a turtle back, and aft a hood. The main deck is of steel, and the upper deck of wood. Steering will be done by steam, and all the latest improvements will be introduced in the equipment. After the launch an adjournment was made to the drawing-loft, where cake and wine were served. Mr. Gershom Gourlay proposed success to the *Loch Rannoch*. He mentioned that she was the first steel steamer built on the east coast of Scotland, and hoped she would be a successful ship. Mr. Mathewson replied on behalf of the owners. The health of Miss Pirie, who christened the vessel, was given by Mr. Henry Gourlay, and replied to by Dr. Pirie. Among the other toasts were "The Owners of the Loch Line," coupled with Messrs. Ireland & Leitch. The vessel was towed into Victoria Dock, where she will be fitted up.

Lochaber.—On the 22nd September there was launched from the shipbuilding-yard of Messrs. Dobson & Charles, at Grangemouth, an iron screw steamer of 350 tons, built to the order of Mr. Wm. Craig Sim, of Glasgow, for the Glasgow and West Highland trade. She is classed 100 A 1 at Lloyd's, and her dimensions are 135 ft. by 22 ft. by 10½ ft. She will be fitted with compound engines of 65-horse power, 400 effective, by Messrs. Scott Brothers, Glasgow. As she left the ways she was named *Lochaber* by Miss Moore, Stathbungo.

Volo.—On the 22nd September Messrs. Robert Duncan & Co., launched from their shipbuilding-yard at Port Glasgow an iron screw steamer, named the *Volo*. The following are her dimensions :—250 by 33 by 20, 1,400 tons, built to the order of Messrs. Strong, Reid & Page, of Liverpool, for their line of Mediterranean steamers. After the launch the *Volo* was towed to Glasgow, where she will be supplied with engines of 150-horse power, by Messrs. Smith Brothers & Co.

Alverton.—On the 23rd September the *Alverton*, an iron screw steamer, of about 1,350 tons, built for Messrs. Osborn & Wallis, Cardiff, was launched from the yard of Messrs. Alex. Stephen & Sons, at Linthouse, Govan. The *Alverton*, which is specially designed for the ore and general cargo trade, has been built under special survey to the highest class in Lloyd's, and has compound surface-condensing engines of 130-horse power nominal. She was named by Messrs. Tonkin, wife of Captain J. S. Tonkin, who is to take command of the vessel.

Esparto.—On the 20th September there was launched from the shipbuilding-yard of Messrs. S. & H. Morton & Co., Leith, an iron screw steamer of 1,250 tons gross register. Her dimensions are:—Length, 240 ft.; breadth of beam, 33 ft.; depth of hold, 17 ft. 3 in. The vessel was named the *Esparto*, and is built to the order of the London and Edinburgh Shipping Company for their foreign trade. She will be fitted with compound surface-condensing engines of 140-horse power.

Thracian.—On the 20th September Messrs. Murdoch & Murray launched from their building-yard, Port Glasgow, an iron screw steamer, built to the order of Messrs. J. & J. McFarlane, of the following dimensions, viz.:—215 by 28 by 16; built to the highest class in Lloyd's. The vessel is specially designed for the Continental fruit trade, having large cargo space and good power, and is calculated to steam 11 to 12 knots an hour. As the vessel left the ways she was named the *Thracian* by Mrs. McFarlane, wife of one of the owners. The machinery will be supplied by Messrs. Wm. King & Co., Dock Engine Works, Glasgow. The *Thracian* left immediately for Glasgow.

LAUNCH.—IRISH.

The British Merchant.—On the 24th was launched from the building-yard of Messrs. Harland & Wolff, at Belfast, a vessel for the British Shipowners' Company of Liverpool. She is named *The British Merchant*, and her dimensions are:—Length, 256 ft.; breadth of beam, 38 ft.; depth of hold, 23 ft.; gross tonnage, 1,780. The vessel will be rigged and otherwise fitted out in Belfast.

TRIAL TRIPS.

Grimsel.—On the 4th September the screw steamer *Grimsel*, built by Messrs. John Readhead & Co., of South Shields, to the order of Messrs. Cay, Hall, & Co., of the same town had her trial trip off the Tyne. The weather was beautifully fine. The following are the dimensions of the *Grimsel*:—Length, 250 ft.; breadth, 34 ft.; depth of hold, 17 ft. 6 in., and 1,300 tons register. The engines and boilers have also been constructed by Messrs. Readhead & Co. The engines are on the compound surface condensing principle, and are of 130-horse power nominal. The steamer has a long raised quarter deck, bridge, and topgallant forecastle. She has complete iron decks fore and aft, the upper deck being sheathed with wood. She is also fitted with water ballast, three steam winches, Harfield's patent windlass, and all the latest improvements. The steamer is classed 100 A 1 at Lloyd's. The vessel, which is commanded by Captain Harland, after having had several very satisfactory runs between Tynemouth and Souter Point, in which she attained an average speed of 10 knots, returned to Shields Harbour, and proceeded to Tyne Dock, where she will take in a cargo of coals for Constantinople.

Liscard.—On the 4th September the new screw steamer *Liscard*, recently launched by Messrs. T. and W. Smith, at North Shields, for Messrs. Arthur Holland & Co., London, was taken to sea for her trial trip. The *Liscard's* dimensions are: 295 ft. length over all; 35 ft. beam; and 25 ft. depth, and she will carry 3,000 tons of cargo. She left the inner tier of Smith's Buoys, North Shields, about 1 o'clock, and proceeded eastwards, straight out to sea, and upon getting between six and seven miles from shore the work of adjusting the compasses was performed. She is fitted with engines of 230-horse power by R. and W. Hawthorne, also steam winches, and Emerson, Walker & Co.'s Patent Windlass. The machinery was put through a series of tests with highly satisfactory results. The work of adjusting the compasses having been completed, the vessel's head was turned inshore, and the engines were kept at full speed until within reach of the measured mile off Whitley. The first spin over the measured distance gave the result of 12 knots, but owing to some little confusion having occurred in taking the time, the course was done over again, this time at a rate of speed between 12 and 12½ knots. The engines acted capitally.

Simoom.—On the 6th September the steamer *Simoom*, built by Messrs. C. Mitchell & Co., of Wallsend, proceeded on her trial trip. The *Simoom* is a vessel of 3,000 tons burthen, is built to the highest class at Lloyd's, but possesses strength even beyond their requirements, and embraces improvements for efficient and economical working. She has been built for the Bedouin Steam Navigation Company, Liverpool, of which Messrs. W. & R. Thomson are the managers. The trial trip was, in the highest degree, satisfactory, the ship, in ballast trim, averaging 11½ knots, and working without the slightest hitch of any kind.

Louise Dagmar.—On the 8th September, the *Louise Dagmar*, the second of the new steamers built for the improved service of the South-Eastern Railway Company between Folkestone and Boulogne made her special trip on the Malpin Sand. The vessel is sister ship to the *Albert Victor*. The result of the trial of six runs, three with and three against the tide, gave a mean speed of 18·64. The trial was in all respects satisfactory. The vessel will proceed to Folkestone next Tuesday.

Irthington.—On the 9th September the steamer *Irthington*, built under special contract to the order of Messrs. William Millburn & Co., by Messrs. Osborne, Graham & Co., Sunderland, and engined by Messrs. Black, Hawthorn & Co., Gateshead, made a satisfactory trial trip. The vessel, of about 2,800 tons deadweight, is of unusually strong construction, with all the modern steam appliances, &c., for saving labour. She attained a very high rate of speed, and gave great satisfaction to the company on board.

Dunbeath Castle.—On the 11th September a trial run was made on the Clyde with the new steamer *Dunbeath Castle*, 220 tons, which has just been built for Messrs. James Henderson & Co., of Wick, for the herring transport trade. The builders are the Campbeltown Shipbuilding Company, and the engines have been made out and fitted by Ross & Duncan, Hyde Park-street Engine Works, Glasgow. The cylinders are 14½ and 26 in. diameter, by 21 in. stroke, compound surface-condensing; the boiler is of the double furnace multitubular type, 70 lbs. working pressure. The propeller is of Ross & Duncan's special make, giving high speed with moderate velocity of piston. On trial, at the easy piston speed of 364 ft. per minute, the speed of the vessel was 9¾ knots per hour.

Sea Queen.—This steamer, lately launched from the shipbuilding yard of Messrs. D. Allan & Company, Leith, left Leith on the 17th of September, and proceeded down the Firth on her trial trip, when a speed of 10 knots per hour was attained. The *Sea Qaeen*, which has been built specially for fish trawling, is about 83 tons gross register. Her dimensions are: Breadth, 16 ft. 6 in.; depth, 8 ft. 4 in.; length, 90 ft.; and is supplied with engines of 130-horse power nominal, by Messrs. Muir & Housten, Glasgow.

Mayo (s).—The fine new paddle-wheel steamer *Mayo*, of 950 tons and 320-horse power, just completed by Laird Brothers for the City of Dublin Steampacket Company, made her official trial in Liverpool Bay with most satisfactory results, attaining a mean speed on the measured mile of about 14½ knots, with an indicated power of 1,600 horses. The *Mayo* is very similar to the *Cavan* and other steamers built for the company by the same bnilders, but is more specially adapted for the cattle trade, in which she will take her place in a few days on the Dublin and Liverpool stations.

City of Liverpool.—On September 23rd the *City of Liverpool*, specially built for the American cattle trade by Messrs. Richardson, Duck & Co., South Stockton, took her trial trip. In ordinary steamers there is great loss of cattle in bad weather, many animals frequently being washed overboard. The *City of Liverpool* has been constructed for Messrs. W. H. Ross & Co., of Liverpool, and has been under the inspection of Captain Patching, so as to secure by special arrangements the transit of cattle across the Atlantic as carefully and safely as human passengers are carried between the two hemispheres. The *City of Liverpool* is 350 ft. over all, 340 ft between perpendiculars, 40 ft. beam, and 29 ft. 10½ in. moulded depth. Her gross tonnage is 3,065, and the net register is 2,000 tons. She is classed 100 A 1 at Lloyd's althongh she is considerably stronger than their requirements. She has two complete iron decks, a long bridge house, and a turtle back forward, so that when carrying cattle on deck the animals can be sheltered. A hood ait shelters the man at the wheel. The vessel is also fitted with beams between the hood and the bridge, and between the bridge and the turtle back. When occasion requires, the beams can be covered in by a wooden covering, and thus completely protect the cattle on the upper deck, the animals, in fact, being as comfortable as though in stables on board. Between decks ample accommodation is provided for carrying cattle. There are long ranges of wooden stalls, which have the appearance of being permanent fixtures, but they are so constructed that they can be quickly and easily removed from the cast iron fittings in case the space is required for dead cargo. In order that the cattle between decks may be kept as healthy as possible, a ventitator, known as the patent blower of Mr. Henry Wilson, of Stockton, is fitted the entire length, and so arranged that through perforated holes in a wooden casing, a constant supply of fresh air is given out above the head of each animal, and the ventilator is further arranged to carry off all foul air through a tube under the beams. The patent blower is situated in the engine-room, where it gets supplied with air, which it rapidly cools. In addition to this patent blower, which is specially constructed for the benefit of the cattle, there are no fewer than eighteen ordinary ventilators. There is also ample provision for water. There are fresh water tanks capable of containing 3,500 gallons of water, and there are also two condensers capable of condensing 500 gallons of water every twenty-four hours. It will thus be seen that the 650 head of cattle which this magnificient vessel can carry will always have [a good supply of water. The vessel is built with complete double bottom for water ballast on the cellular principle, capable of containing 500 tons of water ballast. In the forehold there is a compartment for carrying dead meat. Here arrangements are made for storing ice so as to keep the meat fresh. In addition to ordinary steering apparatus there is a steam steering gear in the wheel-house on the bridge. The bunkers are so arranged that she can carry out 1,000 tons of coal, which will suffice for both the passage out and the voyage home. She is supplied with four horizontal steam winches for loading and discharging, and is fitted with all the latest and most ingenious appliances. Her engines are by Messrs. Blair & Co., of Stockton. The engines are 350-horse power, and are direct acting compound. The vessel is rigged as a three masted brigantine, with a double topsailyard on the foremast. Early yesterday morning she steamed slowly out of the Tees, and cruised about Hartlepool Bay. A company of gentlemen, including Mr. Ross, one of the owners; Mr. Jos. Richardson, the head of the firm of builders; Mr. Littleboy, Mr. William Davison, Messrs. Lloyds surveyors; Mr. G. Y. Blair, the engine builder; and others, went off in a tug and boarded [the *City of Liverpool*. After surveying the vessel, her speed was tried, and she made $10\frac{3}{4}$ knots per hour. A sumptuous luncheon was provided, after which some complimentary toasts were drunk.

NEW LOCK WORKS AT SUNDERLAND.

THE scheme for the improvement of the Port of Sunderland, which the River Wear Commissioners have undertaken in recent years is rapidly approaching completion. We allude to the new lock which will shortly be opened for traffic, and which will, it is anticipated, prove a great boon to vessels, particularly to steam colliers entering and leaving the South Dock. This important work has been going on for about three years. It was projected in 1876, in order to give shipping facilities at this port which would prevent the Tyne on the one hand, and the Hartlepools on the other, from drawing away any of its legitimate trade. The new works occupy the position of the old half-tidal basin, and the object aimed at has been to make a deeper and more commodious entrance and outlet to and from the docks, and one that would be available for the purposes of a lock in order to enable vessels to enter or leave the dock at any time of tide. The old half-tidal basin which was situated where the lock now is had three pairs of gates—two towards the dock, and the other towards the sea—but latterly it was not used by vessels passing in and out of the dock. These vessels used the Hendon dock outlet, and the old entrance was utilized by fishermen and their customers as a sort of fish market. The excellent fish market which has lately been constructed a little further to the south now does duty and more than duty for this place. The old tidal basin was 210 ft. long and 200 ft. broad. The new works, as stated above, have been going on for nearly three years. The cofler-dams were put in in 1877, and the basin was dried in November of that year. The old work was then pulled down, and excavations to the depth of seven feet below the cill of the inner gateway of the basin were made. This having been completed, a commencement was made with the construction of the new lock. On the 18th of December, 1878, the foundation-stone of the inner gateway of the lock was laid by Mr. E. C. Robson, then vice-chairman of the Works Committee, but the work of building was not actually commenced till the 24th of January, 1879. Theexcavation for the outer gate-way was completed by March 4th, 1879, and a commencement was at once made with the masonry. The lock is 480 ft. in length, with a width of 95 ft. at the coping level for the greatest portion of its length, and the depth of water will be 30 ft. in ordinary tides. The two main sluices are 9 ft. by 7 ft. each in size, and it is connected with the Hudson Dock by the inner gateway, with a single pair of gates, having a width of 65 ft. and a depth of water of 25 ft. 6 in., ordinary spring tides. The exit seawards from the lock is by what is called the outer gateway. Here there are two pairs of gates, each 65 ft. in width, and having a depth of water of 27 ft. on the cill. Both of these pairs of gates are supported by strut gates, an entirely new feature in England. These strut gates act as shores for the purpose of keeping the main gates perfectly close to the cill. This is a most important matter, for heavy seas will have to be contended with owing to the lock being so near the sea. The advantage of strut gates over the old system of "shoring up" are very great, for two men can put them in or take them out at any time of tide, whereas under the old system, such as that in vogue at the Hendon Dock, about 15 men are required to put in the shores, and they can only be removed during the fall of the tide, causing great inconvenience at times, for if the tide be high the gates have to be kept shored up after the sea may be fallen sufficiently to enable them to be worked, and traffic is thus temporarily suspended. A further protection against the sea is being provided by the erection of two wave screens, extending seaward and curving towards each other, finishing with roundheads. The channel between the roundheads will be 80 ft. in width. The material used for all these works is of the very best description, and everything is of a most substantial character. The masonry of the lock is composed of freestone and granite, the blocks of stone weighing from 7 to 11 tons each, the whole being firmly set together with Portland cement as mortar. Where the old walls which were taken down were 3 ft. 6 in. in thickness, these are from 14 to 16 ft. thick. They are faced with granite with a heavy freestone coping, and the whole of the masonry in connection with the lock is backed up with concrete placed *en masse*. The gates are made of greenheart timber. All the machinery which has been obtained for working the gates and sluices is on the hydraulic principle, and two five-ton hydraulic capstans have been fixed at the outer gateway, and two three-ton capstans at the inner gateway for the purpose of assisting vessels out and in. An important part of the work being carried on is the erection of a new bridge at the inner gateway to keep up the means of communication between the parts of the dock on either side of the lock. It will be a heavy, massive hydraulic swing bridge, 136 ft. in length, and 20 ft. in breadth. This bridge replaces the whole drawbridge which was erected about twenty years ago to carry a load of 11 tons only. The weight of the new bridge to be lifted and swung is upwards of 360 tons, and the time required for opening it will be about a minute and a quarter. On the sides of the lock six very handsome stone cabins and sluice houses have been built. They are intended for the working of the sluices and for the purposes of the lock men. The Commissioners have also erected a large and commodious stone building as a watch-house for the Pilots. With the view of an early opening of the new works for traffic, extensive blasting and dredging operations have been carried on for the deepening of the water in the old South Outlet channel. This new work, it is expected, will be opened in a few weeks.—*Sunderland Echo*.

STEAM LAUNCHES ON THE THAMES.—A Bill has been brought in by Mr. Charles M'Laren, Mr. Otway, Mr. Walter James, and Mr. Brodrick to regulate the navigation by steam vessels of certain portions of the river Thames. Under this Bill the Thames Conservators are to be able to grant licences for steam vessels at £2 10s. each, lasting not longer than six months, and renewable on the same terms. No person is to use a steam vessel without such a licence. All such vessels are to be registered. Provisions are included by which every steam vessel is to display its registered name and number conspicuously, is to carry certain lights, and not to exceed a rate of eight miles an hour against stream or tide, or four miles an hour with stream or tide, or half those rates at night or in thick weather. Special tolls are to be paid by steam vessels passing locks. The Bill specifies the penalties to be incurred by the owners of steam vessels who disregard its provisions. The Bill is to apply to that part of the river which is within the jurisdiction of the Conservators between Putney-bridge and Cricklade.

THE SOCIETY OF ENGINEERS.

VISIT TO CHATHAM DOCKYARD.

ON September 21st over seventy members of the Society of Engineers and their friends visited Chatham Dockyard and the extension works there in progress. This was the fourth and last excursion of the Society for the year. The party left the Holborn Viaduct Terminus of the London, Chatham, and Dover Railway, in special saloon carriages, attached to the 10.45 Ramsgate fast train. On arriving at Chatham the party was conveyed by a steam tender, belonging to the extension works, from the Sun Pier to Gillingham, where they landed, and where they were taken charge of by Mr. A. Bernays, Superintending Engineer, and Mr. Newton, Executive Engineer in charge of works. By these gentlemen they were escorted over the extension works. Afterwards Mr. Bernays provided an engine and train of wagons fitted up with seats, in which his visitors were taken to the dockyard, where Mr. Penny, assistant master shipwright, Admiral Brandreth, Admiral Superintendent, had given instructions that the visitors were to be shown typical ships, and this object was kept in view. The first ship visited was the *Nelson*, a sister of the *Northampton*. The *Nelson* was built and engined by Messrs. John Elder & Co. She is 280 ft. long between perpendiculars, 60 ft. wide, and draws 24 ft. She has three principal decks, and carries four 18-ton guns, and eight 12-ton guns on the main deck. We cannot better describe this ship than in the words of Mr. King[*] :— "The framing is on the usual longitudinal system adopted in the construction of British ships of war, and in this instance the longitudinal frames are made of steel, so as to combine lightness with strength. The double bottom extends for about 150 ft. amidships, and the space between the inner and outer skins is divided into many water-tight compartments. According to the system recently adopted for armoured ships, there is a central longitudinal bulkhead besides numerous transverse bulkheads underneath the lower deck and wing-passage bulkheads. Altogether, including the spaces between the two skins, there are ninety water-tight compartments; all the doors leading to these compartments are fitted water-tight and worked by machinery, and every conceivable precaution has been taken to provide against destruction by rams and torpedoes. There are three principal decks: The lower, main, and upper. The protecting armour consists of a belt at the water line of about 181 ft. in length amidships; this belt being 9 ft. deep, 4 ft. above water and 5 ft. under water. It is put on in two strakes; the upper strake being 9 in. thick upon a 10 in. backing of teak, and the lower one 6 in. thick upon a teak backing of 13 in. Extending across the ship at each end of this armour-belt there is an armoured bulkhead which extends from the bottom of the armour-belt, 5 ft. under water, to the upper deck, and has in all a depth of 22 ft. Its thickness is 9 in. above water, tapering to 6 in. at the bottom. Between the main and upper decks these bulkheads are shaped so as to form corner ports at the fore and after ends of the battery. Between the armour bulkheads, and at the upper level of the armour-belt, the lower deck is formed throughout of 2 in. plates, so as to protect the machinery, boilers, magazines, &c. The horizontal armour is a peculiar feature of these ships. For about 57 ft. at the fore end there is an armoured deck. This deck is 2 in. thick and 5 ft. under water at the junction with the armoured bulkhead, but inclines deeper towards the stem and terminates forward in the ram. There is likewise a horizontal armoured deck of the same thickness and same depth under water, extending from the after armoured bulkhead to the stern. These submerged armoured decks are intended to protect the lower part of the ship before and abaft the armoured bulkheads, and especially the steering gear provided for emergencies. From the above outline it will be seen that the central part of the vessel for 181 ft. in length, in which all the propelling machinery is contained, may be regarded as completely protected from ordinary shots of the enemy. The ends of the vessel above the submerged decks are entirely unprotected by armour, and may, it is supposed, be riddled with shot without serious injury to the floatation of the vessel. The armament will consist of four 18-ton guns and eight 12-ton guns on the main deck, and six small guns on the upper or spar deck; the latter being intended for use as torpedo-boat destroyers. Two of the 18-ton guns, one on either side forward and one on either side aft, are situated behind the oblique portion of the armoured bulkheads, and the ports are so cut that these guns can command a cross fire at the bow and stern. The eight 12-ton guns disposed equally on either side are termed intermediate, and have in front of them the thin sides of the ship only. They are separated by a transverse bulkhead or splinter screen 1 in. thick, intended to cut off each gun's crew from the others. This broadside of guns is designed to be loaded and laid in close engagement under the shelter of the bow or stern armour, and may be fired by electricity, without exposing the crew. The ram is a heavy plate, triangular in shape, set vertically, and terminating in a sharp point about 11 ft. in advance of the stem; it is supported by two side plates, 3 in. thick, which may be regarded as a continuation of the armoured deck. The rudder, which is massive, is 18 ft. deep by 11 ft. in breadth, and is formed by two thicknesses of teak planking set in a strong iron frame. The vessel has bilge keels 33 in. deep, formed of two plates rivetted together, and extending in length amidships for about 100 ft. The outer bottom of the hull below the water-line is sheathed with a 3 in. thickness of teak, which is covered with zinc. The seams between the strakes of sheathing are left uncaulked. There are to be three masts fitted, as for a full-rigged ship, and the coal-bunker accommodation is sufficient for a long voyage and cruising in distant seas. In time of war it is intended that only the lower masts shall stand. The novelty of design embodied in the *Nelson* and *Northampton* consists in the system of armouring. As may be readily seen, the object aimed at has been to give thicker plates to vessels of this class over the vital parts, at the expense of the exposed parts, and so to increase the offensive power by carrying a heavier weight of ordnance. The machinery of the *Nelson* was designed and constructed under the direction of Mr. Kirk, the manager of the engineering works of Messrs. Elder & Co. She is fitted with twin screws, each to be driven by an independent pair of compound engines, with vertical inverted cylinders, of the collective power of 3000 horses; giving an aggregate power of 6000 indicated horse-power for both pairs of engines. The diameter of the high pressure cylinder is 60 in., and the diameter of the low-pressure cylinder is 104 in. The length of the stroke is 3 ft. 6 in., and the number of revolutions to be obtained on the trial seventy-five per minute. These engines are constructed entirely of wrought iron, steel and brass, except the cylinders, cylinder covers, steam and expansion valves. The two pairs of engines are tied together by wrought iron braces, and are fixed in the ship directly opposite each other. The central longitudinal bulkhead divides the two pairs of engines, and all the pipes are arranged so that, in the event of collision or other casualty to the bottom of the vessel, either pair can be worked separately. The crank shafts are in two parts, interchangeable, 16½ in. in diameter in the bearings, with an aggregate length of bearing of 9 ft. 6 in. The propeller shafts are hollow, and are made of Whitworth's compressed steel. The screw propellers are to be 18 ft. in diameter, to work outwards, and of the *Mangin* type *i.e.*, two two-bladed screws on each boss, separated from each other. The boilers are ten in number, with three furnaces in each, and are set back to back against the longitudinal bulkhead, with the fronts toward the sides of the ship. They are oval in shape, 12 ft. 6 in. wide by 14 ft. 6 in. high, and 9 ft. 6 in. long; and are divided by transverse water-tight bulkheads into four separate fire or boiler rooms. The furnaces are made in short lengths, rivetted together with flanges having distance pieces between them. The pressure of steam is to be 60 lb. per square inch. All the necessary pumps and equipments described for other vessels are here provided."

Visits were then paid to the *Agamemnon*. Concerning this ship we have only space to say that her length between perpendiculars is 280 ft.; breadth, 66 ft.; displacement, 8492 tons; and tonnage 5469. Her engines are of 6,000-horse power indicated, and her armament consists of four 38-ton guns, carried in two turrets, which will be protected by compound armour-plates from Messrs. Cammell & Co.'s Works at Sheffield. From the *Agamemnon* the visitors proceeded to the *Orion*, which has a central battery, and is armed with four 25-ton guns. Her engines are of 3,900 horse power indicated. The next vessel inspected was the *Superb* formerly the *Aamidiyeh*, which, with the *Orion*, at first called the *Bourdji Zaffer*, was originally constructed to the order of the Turkish Government, and afterwards purchased by our own. The *Superb* carries sixteen 18-ton guns, twelve being placed in her battery, two forward, and two aft. She will also carry twelve Whitehead torpedoes, which will be discharged from four carriers, two forward and two aft, at a height of 4 ft. above water level. Her engines are of 7340-horse power indicated.

After these ships had been inspected, the visitors were conveyed on the narrow guage—18in.—railway which runs through the yard to the shed wherein the *Polyphemus* is being built. This vessel is one of the most remarkable ever constructed, and great reticence has been observed by the Admiralty concerning her.

The *Polyphemus* will not be fitted with masts or sails, but will carry a pole for signal purposes. The principal dimensions, &c. are as follows :—

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[*] "The War Ships of Europe." By Chief-Engineer King, U.S.N.

Length between perpendiculars...	240 ft.
Breadth, extreme	40 ft.
Depth of hold	18 ft. 9 in.
Immersed midship section	625 square ft.
Mean load-draught of water	19 ft. 9 in.
Displacement load	2610 tons.
Builders of machinery, Messrs. Humphreys, Tennant & Co.	
Type of engine, compound, horizontal, single piston rod.	
Number of cylinders	4.
Diameter of high-pressure cylinders	38 in.
Diameter of low-pressure cylinders	64 in.
Stroke of pistons...	39 in.
Number of screw propellers	2.
Total weight of machinery, including water in boilers and 10 tons of spare gear	490 tons.
Indicated horse-power, maximum	5500.
Speed of vessel, estimated maximum	17 knots.

The engines are designed for simplicity and saving of weight. The inboard propeller shafts are hollow, of Whitworth's compressed-when-fluid steel. The surface condensers are brass. There are no expansion valves. Many parts of the engine are made of steel. The boilers are of the locomotive type, ten in number, manufactured of Landore steel, and designed to carry 120-lb. pressure on the square inch. The boilers stand athwartships, and are divided into two groups of three and two respectively, with a fore-and-aft bulkhead between them, thus making four fire-rooms in water-tight compartments. The uptakes all lead into one chimney, which is fixed. The engines each occupy the full breadth of the ship. The port engines are aft, the starboard engines forward. She is built throughout of steel, and somewhat resembles Winan's celebrated cigar ship. The *Polyphemus* will carry no guns, save one or two small pieces on deck; but she will be able to launch torpedo after torpedo from the orifice —which resembles the mouth of some fishes—in the cutwater, and about 8 ft. below the water level. But besides this she can discharge other torpedoes at each side. She will be fitted with a ram bow or snout of formidable dimensions. She is divided into a great many compartments by suitable bulkheads, and in her hollow keel, if we may so call it, she will carry blocks of cast iron each weighing 20 tons. Should she take in much water from being pierced by an enemy's shot these blocks can be dropped into the sea at a moment's notice and the ship so far lightened. Her turtle back will be covered with scale armour secured to 2 in. plates. This scale armour consists of a series of tiles, each 10½ in. by 10 in. by $\frac{11}{16}$ in. thick, made of Whitworth compressed steel. The tiles are secured, with one screw stud at each corner, and one in the middle, the whole surface being flush; and it is anticipated that she will be impregnable to any gun which another ship of war could bring to bear upon her. She was begun just two years ago, and will be ready for launching it is expected next March.

After the inspection of the *Polyphemus*, the visitors returned to Chatham by the steamer, and went on to London by the ordinary 5 p.m. train. Among those present were Mr. Joseph Bernays, president; Messrs. Charles Horsley and Jabez Church, vice-presidents; Messrs. Baldwin Latham and Robert P. Spice, past presidents; Messrs. F. E. Duckham, C. Gandon, W. Schönheyder, A. Williams, and P. F. Nursey, members of council; Messrs. W. H. Bennett, A. Meade, W. A. Valon, A. Le Grand, E. W. Brooking, F. E. Houghton, T. H. Martin, and B. Reed, secretary.

Reviews.

The Boiler-makers' Assistant in Drawing, Templating, and Calculating Boiler and Tank Work, &c. By JOHN COURTENAY, Practical Boiler Maker. Revised and Edited by D. Kinnear Clark, C. E., Weales, Rudimentary Series.

The fact of this little treatise of 100 pages forming one of Weales' well known series is sufficient guarantee that its subject is handled by a practical man. The author in his prefaces describes his own want of a low-priced handy book which would, combined with practical information, supply the few necessary tables usually found imbedded amongst extraneous matter in bulky volumes. The book thus contains the contents of "his private note book of rules," jotted down, it is true, without much scientific arrangement or precision, but in a way which will doubtless prove sufficiently intelligible to the journeymen and apprentices who peruse. We find some of the simpler geometrical definitions and formula, the ordinary rules for proportioning boilers and safety valves, calculating tensile and other strains, the contents of tanks, &c. The tables include decimals of feet and inches, circumferences and diameters of circles, weights of plates, bars, and angle irons, &c. The special feature and *raison d'être* of the book is Chapter VI. which treats of templating, giving rules for developing cylinder knees and elbows, multiple bends, steam domes, rake of funnels, conical plates, &c., &c. These problems are solved in a thoroughly practical manner, and illustrated by copious and clear diagrams which are valuable for pretending to no more than what they are, the marks a workman would trace with his scribe on the plate he desires to cut. We believe there could be few better teachers for a young apprentice at the bench than the author of this little manual.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

To the Editor of the MARINE ENGINEER.

SIR,—I have been greatly puzzled by the following problem. May I ask some of your correspondents to solve it for me?

In a three cylinder compound engine the sectional area of smallest or No. 1 piston is 100 inch, and sectional area of No. 2 piston is equal to 1st plus $\frac{1}{2}$ of 3rd piston area: 3rd piston has an area equal to 1st plus 2nd and the stroke is equal to $\frac{1}{12}$ of the combined area. What is diameter of each cylinder, and the stroke in inches.

Yours truly,

19th September, 1880. PUZZLED.

To the Editor of the MARINE ENGINEER.

SIR,—I notice an article in your contemporary, the *Engineer*, on the practical care of Marine Boilers by a Sea Going Engineer, in a portion of which he refers to the use of internal lubricants, and seems rather to prefer glycerine to Crane's Oil allthough admitting the latter to be an admirable lubricant. Will you kindly grant me space in your valuable journal to ask the Sea Going Engineer two questions, 1st. Is glycerine a lubricant at all, 2nd. Can it maintain its efficiency in the presence of steam and water, as it is so very soluble in the latter?

I am, &c.,

September 25th 1880. ENGINEER.

THE LIVERPOOL LANDING STAGE.—The erratic movements of the Pluckington Sandbank continue to cause much inconvenience, if not uneasiness, on the Mersey, and unless the engineer promptly carries out the sluicing operations with which he hopes to clear away the sand, the great landing stage may be rendered useless, the bank continuing to encroach northward. The highest tide of the year was on Sunday morning, when the Mersey rose 20 ft, 5 in. above the level of the old dock sill. At low water it fell 10 ft. 6 in. below the level of the old dock sill, making the actual rise and fall of the water 30 ft. 11 in. The south portion of the stage was left high and dry, and for a length of 500 ft. the ferry berthage was unapproachable by the steamboats. This necessitated a re-arrangement of the traffic, which had to be worked in half the usual space. The Birkenhead steamers, both on Sunday and Monday, had recourse to the Seacombe berthage, and the Wallasey steamers were worked off the south portion of the goods stage, opposite the floating bridge, while the immense luggage steamers plying to the various ferries were stationed in the embayment. The boats from the southern ferries were afforded accommodation north of the embayment. Many thousands of passengers crossed the river by the various ferry-boats, and notwithstanding the extraordinary exigency caused by the low tides and the encroachments of the Pluckington Bank, the traffic was conducted without a hitch.

LAUNCH OF THE "ITALIA."

ON the 29th of September there was launched from the Dockyard Castellamere the Italian War Ship *Italia*. An immense crowd streamed forward to the dockyard from an early hour. Within an enclosed space in the dockyard a vast hull rose like a mountain. The sight was a very striking one. The King's Pavilion occupied the centre of a long line of raised galleries to the right of the vessel, and the seats were all occupied by people waiting to see the splendid ship launched. At the upper end, near the prow, a temporary chapel was erected, formed of gaily coloured bunting, with the cross of Savoy standing out prominently on the roof. The rich silver ornaments of the altar were seen between the flags; the robes of the priests added a striking effect of colour, and hundreds of bloused workmen, mingling with brilliantly dressed officers and black-coated Senators, were complacently regarding the finished work, which did not look as if it could have been made by the pigmies crowding around its mighty hull.

The sea was crowded with craft within a respectful distance of where the leviathan ship was to take water. The English vessels, the *Monarch* and the *Thunderer*, like all the rest were gaily dressed with bunting to do honour to the occasion.

The arrivals of Foreign Ministers and Envoys excited much interest in the crowd, and the new Japanese Ambassador received a special share of attention. Then came the King, amid a thundering of cannon and a burst of cries of "Evviva!" He at once made a complete tour of the ship. A procession of priests was then formed, and they, too, walked round the vessel, chanting and sprinkling holy water, and it may be remarked that this part of the ceremony was received with distinct derision by a majority of the crowd.

The daughter of the Minister of Marine having christened the ship, there was a trumpet-call signal for knocking away the last supports. This was an anxious half-hour, but all went with admirable smoothness and precision, and the *Italia* glided away to the sea—on which she is now the strongest war ship afloat—amid a scene of indescribable enthusiasm.

In the construction of the *Dandolo* and *Duilio*, Italy followed closely upon the heels of the British navy, and in introducing an armament of 100-ton guns, gained superiority in that respect, at least, over the *Inflexible*. But now the *Inflexible* has been left behind by the mighty *Italia*, which will soon be followed by her sister ship the *Lepanto*. To draw a rough comparison between the *Italia* and *Inflexible*, the former exceeds our own "latest type" by eighty feet in length; one thousand nine hundred and eighty tons displacement, and as much as seven thousand indicated horse power, for it is anticipated that her engines will develop the power of fifteen thousand horses, and drive the ship at a speed of sixteen knots. In breadth of beam and draught of water the ships are much alike, but in armament the *Italia* far exceeds the *Inflexible*, having four 100-ton guns, and eighteen six-inch guns, to the *Inflexible's* four 80-ton guns. In building this monster engine of war, Italian naval constructors have not confined themselves to a beaten track but have introduced some novel designs. No attempt to cover with armour the whole of the sides of this vessel, having a length of four hundred feet between the perpendiculars, has been made, this protection having been retained only for the fighting and motive power of the ship. Armour has only been used to keep projectiles from entering the most vital parts of the vessel, the engines, boilers, magazines, and shell rooms, and the channels leading from these portions of the construction to the upper deck, and to shield the guns and their crews in the casemate on the upper deck. The four 100-ton guns, by Armstrong, will be mounted, *en barbette*, in pairs, in this casemate battery, and they will be worked by the hydraulic system, perfected by the Elswick firm and introduced on board Her Majesty's ships, while the principle of mounting is the same as applied to the barbette guns on board the *Téméraire*, but when run up for firing the guns of the *Italia* will be fully thirty-two feet above the water-line, and will be able to fire in line with the keel, and in fact in any direction. On the upper deck, which is twenty-five feet above water-line, there will be six six-inch guns, including a bow chaser and stern chaser, while on the battery deck, fourteen feet above water line, there will be twelve of these guns. Among her other means of offence are four ports from which she will be able to discharge Whitehead torpedoes, and she is also fitted with a ram, which projects 6 ft. 4 in. beyond the perpendicular, and is placed 8 ft. 6 in. below the water-line. The hull of the vessel is constructed of steel, sheathed with wood, and her double bottom is divided into numerous cellular spaces. There are also two longitudinal bulkheads extending for more than half the length of the ship, and a number of transverse bulkheads, dividing the ship into nearly sixty large water-tight compartments, which are again sub-divided by her four water-tight decks. The lowest deck is armoured with three-inch plates, but the others are of steel, covered with planking.

Great as was the controversy raised as to the danger resulting from the liability of the *Inflexible* to be pierced with shot at her unarmoured ends, the Italian constructors have carried the idea of partial armour to a far greater extent than in the *Inflexible*; for although the *Italia* is so much larger a vessel, she is designed to carry some 300 tons less of armour. But while thus discarding in a measure the warning voice of Sir Edward Reed against the abandonment of side armour, the "cork belt," as introduced in the *Inflexible*, has been adopted in the *Italia*, and by the subdivision of the ship into numerous water-tight compartments every effort has been made to secure sufficient buoyancy, even if her unarmoured ends should be considerably damaged under the fire of an enemy.

The engines are by Messrs. Penn, of Greenwich, and are by far the most powerful yet placed on board any armoured vessel, it being estimated that the development will be in excess of one indicated horse power to each ton of displacement, or 15,000-horse power to the vessel's 13,480 tons. There are two sets of engines to each of the two screw shafts, giving twelve cylinders altogether, and steam will be generated in 26 boilers having 78 furnaces. Twelve of the boilers are placed aft, and the remainder forward of the engines, and as a rule in ordinary cruising the after engines and boilers will be those used, full power being required only under exceptional circumstances. The engines are of the same type as those of the *Agamemnon*, being so arranged that they can be worked either on the compound or non-compound system.

TORPEDO BOATS.

THE arrival in the Mediterranean of a Russian torpedo boat, of a new and exceptionally powerful character, adds to the interest which attaches to this description of naval force. It is a matter of considerable moment to observe that this little vessel, so formidable in proportion to her size, and perhaps destined to be the forerunner of a specially powerful torpedo fleet, was launched on the Thames, her builders being Messrs. Yarrow & Co., of Poplar. It speaks well for the naval supremacy of England that foreign powers find it necessary to have recourse to British builders in order to obtain torpedo boats of a really efficient kind. Efforts are indeed made abroad to construct torpedo boats, and many have thus been built in North Germany; but when first-class work is desired England is recognized as the only source from which it can be obtained. The famous Herrashoff torpedo boat from America, despite her remarkable qualities, cannot be said at present to furnish an exception to this rule, as she has not yet fully emerged from her experimental stage. There is so much that is peculiar in the building of torpedo boats that even in England there are only two firms who appear to have achieved permanent celebrity in this department. Some two or three others have exhibited a certain degree of success, but the bulk of the business remains with Messrs. Yarrow & Co., already mentioned, and Messrs. Thorneycroft & Co., of Chiswick. These two firms have supplied nearly all the torpedo boats belonging to the Royal Navy. It happens just now that the Poplar firm are occupied wholly with foreign orders, their yard being full of work for the supply of other Governments than our own. There seems to be a general agreement that the torpedo is calculated to play an important part in the naval wars of the future. France is providing herself extensively with torpedo boats, and Russia has a large and efficient fleet of these peculiar craft. Sweden and Norway, weak in the element of ironclads, are arming themselves against the navies of other nations by making torpedo boats a special source of strength.

In tracing the growth of the British torpedo fleet we may go back to the period of the *Vesuvius*. The date is a recent one, as the vessel commenced her career only five years ago. She is a double screw iron torpedo vessel, of 260 tons displacement, and 380-horse power indicated. She is 90 ft. long, 22 ft. broad, with a draught ranging from seven to eight feet. She carries ten torpedoes, launched from submerged tubes. From this early type we proceed to the steel torpedo boats of the first-class, 86 ft. long by rather less than eleven feet broad, having a displacement of about 30 tons. Propulsion is exercised through a single screw about five feet in diameter. It is the necessity of immersing this screw which gives the boat a greater draught at the stern than elsewhere. The vessel can carry all her weights with a draught of 18 inches, but in order to carry the propeller in a proper position a draught of a little over five feet is requisite at the stern. This downward range of the screw is to be born in mind whenever statements are made as to the draught of torpedo vessels. It also applies to other and more ambitious craft. Thus the Czar's remarkable yacht, the *Livadia*, has been credited with a shallowness of draught which entirely excludes the much greater depth requisite for the screw propellers, In our second-class torpedo boats, which are 60 feet long by 7 feet 8 inches beam, the draught forward is only about a foot, whereas at the stern it is 3 feet 4 inches, the diameter of the screw being about 3 feet. The displacement of these smaller vessels is about 10½ tons. Like the first-class boats, these are made of steel, and have a high velocity. This question of speed is of paramount importance in vessels whose chance of success in warfare depends largely on their power to advance and retreat quickly. Every effort is made to obtain the highest possible speed. Some of the first-class torpedo boats in the British service have registered a speed of nearly 22 knots—about 25 miles—per hour, and some of the second-class attain to 17 and 18 knots, or about 20 miles per hour.

The first-class torpedo boat may be said to have come in with the *Lightening*, built by Thorneycroft, and finished in January, 1877, having a displacement of 28 tons, and engines of 400-horse power indicated. At the commencement of the present year the total of torpedo vessels afloat and completing, belonging to the British service, was 45. To these may be added, perhaps, as many as 20 since taken in hand. The first-class torpedo boats are not intended to be carried on board ship, their size and weight rendering the hoisting in and out peculiarly difficult, though the achievement is not impossible, and they might very well be carried in ships specially fitted for the purpose. But they are intended to keep the water somewhat on their own account, having a port as the base of their operations. It is different with the second-class torpedo boat. This would be generally allied to a ship, and would be carried on board, ready to be lowered over the side and sent on its errand at any moment. Nearly all our ironclads are able to carry two of the second-class boats. The new Russian torpedo boat introduces an entirely novel type of torpedo vessel, not merely capable of running in and out of port and defending the offing, but able to go on a cruise of her own. Her speed at the measured mile is said to have exceeded 22 knots an hour, and she carries enough coal to last for a run of about 800 miles, at a speed of 10 or 12 knots an hour. She carries the Whitehead torpedo, and is fitted so as to launch two of these weapons almost simultaneously. Claiming to have a somewhat higher speed than the *Lightning* class—which she exceeds in size—the Russian boat is likewise able to use a moderate sail power in the event of her engines breaking down. Altogether she appears to be a well-contrived and powerful vessel of her class, and Russia will doubtless have others built on the same plan. In addition to her powers as a torpedo boat, the Russian vessel has her stem shaped and strengthened into a sharp ram.

We cannot speak of the *Polyphemus* as a torpedo boat, and yet we cannot wholly pass her by in discussing the construction of vessels specially designed for torpedo warfare. This strange production, now building in the Royal Dockyard at Chatham, towers far above the class of vessels we have just described. Her designation is that of a steel armour-plated torpedo ram, propelled by a double screw. Her displacement is 2640 tons, and her engines are estimated to have 5500 indicated horse-power. Her calculated speed is between 16 and 17 knots. The length of this strange vessel is 240 ft., with a breadth of 40 ft. Her vertical transverse section is very much that of a peg-top, and only a very small portion of the hull will appear above the water, the part thus exposed presenting no vertical surface, but only a long, narrow, convex figure like the back of some huge fish akin to the sea-serpent. A hurricane deck will be carried aloft, upon which will be placed the boats and some other appliances. Armed with a powerful ram, this vessel will possess no other weapon of attack except the Whitehead torpedo and a few machine guns. The *Polyphemus* may possibly be launched before the close of the year, but we may expect that a number of experiments will be tried with her machinery before she is actually ready for service. A war vessel of such a size, without any piece of ordnance on board that can properly be called a gun, exhibits in herself a bold departure from the usual style, and the *Polyphemus* is in all respects an extraordinary ship.

The *Hecla* is a vessel apparently destined to play an important part in the torpedo service. She is a large torpedo depot ship, having a displacement of 6,400 tons, and able to carry half a dozen second-class torpedo boats, to be dropped when and where they happen to be wanted. The *Hecla* is also fitted with a splendid workshop or travelling factory for the execution of repairs, especially in connection with the torpedo service. In addition, she carries a large stock of torpedo stores, including counter-mines, gun-cotton, &c. Altogether she is worthy of her name, as holding in her capacious hull a mass of volcanic forces. Besides all these, she has space and flotation for some 1,500 tons of coal. She may be considered a bit of Woolwich Arsenal detached and sent afloat.

The dreaded torpedo boats, any one of which might destroy an ironclad costing half a million sterling, are in one respect a very frail kind of craft. Each boat is strong enough on the whole, but there is one insidious foe against which the torpedo flotilla offers but a comparatively feeble resistance. These little vessels have the strength of steel, but the metal is very thin, and the corrosive action of sea-water consequently becomes a serious consideration. An iron plate three-quarters of an inch thick, forming the bottom of an ironclad, and a steel plate one-eighth of an inch thick, forming the hull of a torpedo boat, are each equally subject to the process of oxidation. But there is this difference between the two—that while an amount of "pitting" which goes one-sixteenth of an inch deep, only takes away one-twelfth of the thickness of the iron plate in the big ship, it takes away half the thickness of the steel plate in the torpedo boat, and another sixteenth destroys the safety of the boat altogether. Thus corrosion is a serious question with all iron or steel vessels, but while it is hurtful to an ironclad it may be very soon fatal to a torpedo boat. Hence the latter only visits the water occasionally, and its usual lot is to be hauled up high and dry. The torpedo boat is associated in the public mind with a destructive force which seems almost rude and barbarous in its character. Nevertheless, the little vessel which thus threatens the most powerful war ship of the day is itself a very delicate contrivance, and needs almost as much care as a drawing-room clock. Of course, the precaution is taken of protecting the bottoms of these vessels by the use of anti-corrosive preparations; but these are not to be absolutely relied upon, and hence the vessels are never needlessly exposed to the deteriorating effects of sea water. The susceptibility of steel to this kind of mischief suggests the use of another metal less liable to such corrosion, and an attempt has been made to utilize manganese bronze for the purpose.

The use of ship launches for torpedo service is a very subordinate part of the question now before us. The steam launch carried by our ships of war travels at no greater rate than eight or nine knots an hour, and is armed with the spar torpedo only. Doubtless such boats might make use of the Whitehead torpedo, but they would do so at a great disadvantage, owing to the slowness of their movements. The introduction of torpedo boats has given an impetus to the use of machine guns in the Navy, and the little vessel which carries the torpedo needs all possible swiftness in order to ensure her own safety. Where it is possible to take the enemy by surprise a slow-moving boat may be sufficient; and the spar torpedo has one merit, namely, that if it acts at all it makes a dead hit, whereas the Whitehead torpedo may utterly miss its mark. For the destruction of an ironclad it would seem necessary that she should be attacked by a swarm of torpedo boats. Several of these might be sunk or crippled by the fire of machine guns; but if only one of the number succeeded in sending the Whitehead torpedo fairly home, so as to strike and explode below the ship's water-line there would be an end of the ironclad, unless her water-tight compartments were so well arranged and so effectually managed as to save her from sinking. Menaced by torpedo boats, it is certain that the most impregnable ironclad would have enough to do to take care of herself. If she destroyed the whole swarm, the enemy would suffer no great loss; whereas if she were so shattered as to founder the sacrifice of life would probably be great, and the loss to the taxpayer would certainly be large.—*Standard*, Sept. 7, 1880.

Notes and Novelties.

THE United States Navy Department has recently adopted a new form of engine as an experiment in what can no longer be called a "steam" launch. This machine is the Brayton Petroleum Engine, a sort of gas engine, which makes the gas as it is required, and which needs neither water, coals, nor gas—only crude petroleum. The machine has proved its usefulness in many ways, for it has been invented several years; but the great advantages it offers in the case of screw launches, are that it costs little in running, is always ready, requires no boiler or chimney, and does not emit either steam or smoke. The fact that it dispenses with a boiler and coal-bunkers is sufficient recommendation, for space in a steam-launch is greatly reduced by those neccessary parts of its economy; but, besides that, there is with the petroleum engine no risk of explosion, and a very large supply of fuel can be readily carried in suitable tanks arranged in odd corners of the vessel. The experimental trials with this launch will be watched with interest by engineers in this country, for the Brayton Hydro-carbon Engine is, perhaps, not seen at its best on land.

THE Baltimore Pilot's Association have taken kindly to the use of steam pilot boats, and are having built for their use a first-rate sea-going steamer. The new vessel is intended to carry sea pilots, with fuel, stores, and accommodations for a month's cruise. The hull will be of iron, with close iron bulwarks at each end, and, with iron siding, forming a quarter-deck for about 68 ft. of the middle run of the boat. The quarter-deck will stand 3½ ft. above the main-deck, which will extend about 30 ft. from the stem and 20 ft. from the stern. Both the main and quarter-decks will have iron deck beams, and will consist of heavy pine deck stuff. The pilot house and captain's room will be on the quarter-deck, where the boarding yawls will be carried. The length will be 113 ft. between main posts, and 122½ ft. over all; extreme moulded beam, 23 ft.; depth, 12¾ ft.; from base line to the top of quarter-deck, 18 ft. There will be one iron athwartship collision bulkhead $\frac{3}{16}$ in. iron, braced, and one forward of the boiler. Coal bunkers on either side of the boiler hold 40 tons each. Below the quarter-deck will be the main cabin, with twenty sleeping berths, wash-room, mess-room, kitchen, pantry, chief engineer's room, and storerooms. The forecastle will contain ten bunks, storerooms, &c. The vessel will be heated throughout by steam. She will have two masts, schooner-rigged, two 17 ft. yawls, two 1,000 gallon water tanks, three anchors of 800, 500, and 175 lb. weight, 120 fathoms chain cable, and a pump brake windlass. The machinery will consist of an inverted direct-acting compound engine, with 22 in. and 36 in. cylinders, 26 in. stroke, fitted with tubular surface condenser, and air, feed, bilge, and circulating pumps, one cylindrical return tubular boiler, to carry a working pressure of 70 lb. of steam to the square in. an independent feed-pump to supply boilers, wash decks, fire service, &c. This pioneer seagoing pilot steamer is now building at Wilmington, Del., by the Harlan & Hollingsworth Company.

NEW IRONCLAD.—Another vessel of the "bird" class is to be built in Her Majesty's Dockyard at Sheerness. The last sloop of that series constructed there was the *Kingfisher*, which has just been finally conpleted ready for sea and commissioned by Captain R. H. Thornton. The Admiralty authorities have decided to give the vessel, whose keel is now being laid down on the building slip at the Sheerness Yard, the same appellation as its predecessor, with the prefix "New" by way of distinction. The new vessel will be constructed like the *Kingfisher*, subject to some minor alterations in matters of detail. The former will be a somewhat larger ship, as she will be 30 ft. longer, while she will also have an additional breadth of two ft. Steel will be more extensively employed in the construction of the present vessel than in any of the previous composite sloops; the framework is to be made of iron and the bulkheads of steel. The engines and boilers are to be protected by two thicknesses of 5-8 iron plate which, it is believed, will not only be a protection when the ship is in action, but will also tend to prevent flooding of the engine-room in the event of an accident or rough weather. The new ship will also probably be fitted with what is termed the "feathering arrangement," the aperture for propeller being dispensed with. The dimensions of the *New Kingfisher* are :—Length between perpendiculars, 200 ft.; extreme breadth, 38 ft.; draught of water forward, 12 ft. 9 in.; aft, 15 ft. 9 in.; displacement in tons, 1,420.

THE present Board of Admiralty are evidently not disposed to allow foreigners the same run of the service and the dockyards which they have hitherto enjoyed. Naval *attachés* are still permitted to attend gunnery and other experiments from which our own officers and the public are excluded, but all other foreigners are rigorously stopped at the dockyard gates unless they are favoured with a letter of introduction from their lordships to the superintendents. Another change deserving of notice has also lately taken place. Hitherto the English Navy has formed an excellent training school for officers belonging to the Chinese and Japanese navies, and the Admiralty have even carried international courtesy to the extreme length of permitting English officers and seamen to navigate the men-of-war purchased in this country to Hongkong and Japan. Their lordships have now, however, seen the necessity for drawing the line; and, while allowing young Chinese and Japanese officers to study at the Royal Naval College at Greenwich and to serve as sub-lieutenants on board our ironclads, they have refused them permission to learn gunnery on board the *Excellent* and the mysteries of torpedo warfare on board the *Vernon*. Japan and China are fast becoming naval Powers, and, while permitting our manufacturers to provide them with ironclads and ordnance, the Admiralty probably think that it is carrying generosity to the extent of folly to teach them how to use their tools.

ABOUT a fortnight since a little vessel, just 100 ft. long, with 12½ ft. beam, and having a mean draught of 3 ft. 6 in., left the South-West India Dock, where she was fitted out for the Black Sea. This craft is a torpedo boat, which has just been built for the Russian Government, and which is the most formidable vessel of her class now afloat. She is, in fact, a sort of torpedo cruiser, and as such embodies several special features, various structural improvements having also been introduced into her by her builders, Messrs. Yarrow & Co., of Poplar, and which combine to render her worthy of notice. She is fitted with very powerful engines, which have carried her over the measured mile trials at a speed of above 22 knots an hour. As a precautionary measure, and in order to provide against an emergency or a break-down of her engines, the boat is provided with three short masts, each of which will carry a small sail, the masts being easily removed and stowed away when not in use. She will carry about 10 tons of coal, which, it is anticipated, will allow her to make a run of about 800 miles at a speed of 10 or 12 knots. She also carries 130 gallons of fresh water, spare gear for the engines, and other nececsary stores. The stem of this vessel is in the form of a sharp ram, and the forward portion of her deck forms a kind of hood, reaching back to the conning tower, and having doors at the rear. She carries Whitehead torpedoes, which are introduced through these doors into the launching tubes, of which there are two. They are placed side by side, parallel to the centre line of the boat, and project just outside her bows, giving her a very warlike appearance. The torpedo gear was not fixed in position when she left England, but we understand it will be put on board at Fiume, where she will call for that purpose. The vessel is steered from the conning tower when in action, and from the deck at other times. She is fitted with a bow rudder, upon the principle lately introduced by Messrs. Yarrow in this class of vessels. The little ship is provided with one of Sir William Thomson's patent compasses, life belts, and cork mattresses for the crew. There is a comfortable cabin for the officers, and good quarters forward for the men. Her crew consists of three officers and nine men, and according to the latest advices from Gibraltar, she has safely reached that port. From what has been stated, it will be seen that this Russian torpedo boat possesses several advantages over those of the *Lightning* class. Her speed is higher, and her torpedo gear is, under the forward raised deck, and is therefore well under cover and she can discharge two torpedoes, one after the other, with an interval of only a few seconds. The theory is that the first torpedo will, if needs be, break through such defences as nets, booms, and the like, thus clearing the passage for the second one, which is to reach and act upon the enemy's vessel. She will carry two spare torpedoes on deck, the other two being placed in the launching tubes. Taking this into account, and coupling with it the fact that her speed is great and that her steaming powers are considerable, owing to her large coal-carrying capacity, this boat may be considered as being to a certain extent independent, and capable of making a dash at an enemy a hundred miles off. Should she show herself to be a good sea boat during her voyage through the Mediterranean she will undoubtedly prove a very valuable addition to the Russian topedo fleet, and possibly the prototype of many more boats of her special build.

THE STEAM YACHT "ANTHRACITE."—On the 28th September, a party of gentlemen, including Admiral Selwyn, Captain Ashby, Mr. M'Farlane Gray, of the Board of Trade, and others interested in steam navigation, accepted the invitation of the Perkins Engine Company to make a run in the steam yacht *Anthracite*, which has just returned from her remarkable trip to America and back. The object of the run was to afford those interested an opportunity of examining the vessel and her machinery immediately after her four months' cruise. It will be remembered that in May last this little vessel, which is only 27 tons register, 70 tons gross, was commissioned to make a voyage across the Atlantic for the purpose of testing the working of the Perkins high-pressure system at sea, and of demonstrating its advantages for ocean work. Her voyage out and home was most successful, and Tuesday's trip showed that her engines and machinery were none the worse for wear after having steamed 10,000 miles with the steam pressure varying from 300 lb. to 400 lb. per square inch all the time, during which it appears that no repairs whatever have been necessary to either her engines or boiler. The total number of revolutions made by the engines since starting from England is 8,484,245. The *Anthracite* is not only the smallest steamer that has ever steamed across the Atlantic, but is probably the only one of her size in England that could perform such a feat. Her engines worked most satisfactorily during the run which was made from Erith to Thames Haven and back to Blackwall, a steam pressure of 350 lb., and 130 revolutions per minute being steadily maintained throughout.

A SAMPLE plate of the side armour intended for the protection of the *Conqueror*, armour-plated turret ship, building at Chatham, was tested on board the *Nettle* at Portsmouth. The test plate measured 6 ft. 3 in. by 7 ft., and had a total thickness of 11 in., of which the outer face was formed of 3 in. of hard steel. It was manufactured by Messrs. Cammell & Co., of Sheffield, the contractors for the turret armour of the *Inflexible*, and is the first sample of compound steel-and-iron armour which has been specially rolled for the side protection of an English ship of war. The depth of steel surface is half an inch less than that of the compound armour of the *Inflexible*, while the thickness of iron is 2½ in. more, a difference which is considered a material improvement, as the steel face is sufficient to break up the projectiles fired against it, while the additional thickness of iron backing affords a greater defence against racking, and prevents the plate from falling to pieces under repeated blows. In the case of the *Ajax* and *Agamemnon*, again, the same principle will be carried a step further, the turret armour being manufactured of a single thickness the steel in the face being 5¼ in. and the iron backing 10¾ in. The testing on Tuesday was very successful. Three Palliser chilled projectiles, weighing, with gas check, 270 lb., and having a striking velocity of 1,406 ft. per second, were discharged at the plate from the 9-inch gun with battering charges of 50 lb. of pebble powder, at a range of 30 ft., the points of impact, which were arranged in a triangle, being 2 ft. apart. None of the shots penetrated. The head of one buried itself to the depth of 6 in., the remainder being broken into small fragments. The conditions under which these armour tests take place are eminently unreal in their character. The gun is placed at right angles with the target, while in actual warfare it would be quite the exception for a shot to strike a ship otherwise than at a considerable angle. Experiments are about to be carried out at Portsmouth with the object of determining the effect of angular fire upon armour with various kinds of projectiles, and, as the results will have a very practical bearing upon the great conflict between armour and artillery, the experiments will possess unusual interest.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 20th August to 16th September, 1880.

3379 D. Joy. Steam engines.
3383 J. Wetter (communicated by E. A. McMann). Safeguards for sleeping berths.
3388 J. G. Walton. Increasing circulation of water in marine and other boilers.
3402 J. Taylor. Screw propellers.
3406 A. Sweet. Screw down valves.
3408 R. Grahame and C. E. A. Baloche. Steadying floats for use on board ships and boats, applicable as life-saving apparatus.
3444 F. C. Glaser (communicated by J. L. Piedboeuf). Steam boilers.
3459 W. E. Gedge (communicated by P. Duval). Insubmersive or unsinkable boats and ships.
3483 F. C. Simpson and J. B. Denison. Feed and air pumps.
3484 J. A. and J. Hopkinson. Steam boilers.
3486 W. J. Griffiths. Screw propellers, placing and arranging, and form or construction.
3489 J. Kennedy. Governors for marine and other engines.
3491 Sir W. Palliser. Firing apparatus for guns.
3495 C. Kesseler (communicated by C. Schwanitz). Steam joint packing.
3503 T. Forster. Flexible boats or preservation of life at sea.
3514 W. Payton and A. Wilson. Steam engines and boilers partially applicable to pumps.
3515 W. R. Lake (communicated by G. H. Flower). Lubricating apparatus.
3520 H. A. Bonneville (communicated by J. Belon). Reviving spent steam.
3522 G. Temple. Means and apparatus for generating motive power.
3526 W. M. Brown (communicated by J. T. Hancock and W. R. Park). Valves and means for operating same.
3530 F. Hart. Steam heating apparatus.
3535 J. F. Fisher. Apparatus for notifying why a vessel is missing, and other particulars.
3549 W. H. Wheeler. Measuring distances and range finding.
5563 W. P. Thompson (communicated by T. Elcoate). Air, circulating, and other pumps for marine engines, and for other purposes.
3565 C. W. Meiter. Signals for steam or other vessels.
3582 G. F. Harrington. Propelling vessels.
3603 P. G. B. Westmacott. Machinery for discharging grain and like cargoes.
3606 A. J. Stevens. Expansion valve gear.
3614 F. H. F. Engel (communicated by G. Reuter). Mechanism for driving boats.
3629 J. D. Ellis. Armour plates.
3635 A. S. F. Robinson. Governors.
3661 T. P. Walker. Propulsion of vessels.
3667 C. D. Abel (communicated by E. Borde, J. Petit Loroche, and E. Labalette. Apparatus for raising and lowering objects.
3673 A. C. Engert. Prevention or more effectual consumption of smoke.
3697 J. Parker. Fuel economizers.
3704 C. Jones. Screw propellers.
3706 W. W. Girdwood. Machine to regulate the admission of steam to engines with great exactness.
3713 C. Haslett and J. G. Thomson. Apparatus for raising sunken ships.
3718 W. Adair. Motive power engines.
3726 D. A. Horsnell. Furnaces and fire bars.
3734 A. M. Ritchie. Appliance or ball for signalling at sea or on land.
3738 G. J. Archer. Floats for fishing purposes.
3739 W. R. Lake (communicated by J. Prégardim). Steam boilers.
3751 R. Sutcliffe. Steam engines.
3768 A. M. Clarke (communicated by L. G. Jobet). Tube stopper for steam boilers.
3769 J. G. Jones. Governor.

BOARD OF TRADE EXAMINATIONS.

Return of engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

Marshall, Jas. T.	2 C	N Shlds.
Dent, Joseph ...	2 C	do.
Meldrum, Wm.	2 C	do.
Hunter, Robt. S.	1 C	do.
Kidd, James W.	1 C	London.
Black. James S.	1 C	Lvrpool.
Burdon, John ...	2 C	N Shlds.
Porritt, Edwin ...	2 C	do.
Dedge, Chas. W.	2 C	London.
M'Ewan, William	1 C	do.
Williamson, D.	2 C	Glasgw.
Milne, George ...	2 C	do.
Hay, Robt. E. ...	2 C	do.
Kerr, George ...	2 C	do.
Doctor, William	1 C	do.
Gray, James ...	2 C	do.
Smith Charles ...	1 C	do.
Wilson, George	1 C	do.
M'Gregor, Geo.	1 C	do.
Harris, William	1 C	do.
Paul, John ...	1 C	do.
Williamson, H.	2 C	Lvrpool.
Sharp, Matthew	2 C	do.
Robbie, Alex. ...	2 C	do.
Kinread, J. H. ...	2 C	do.
Constaninidi, C.	2 C	do.
Prodham, Chas.	2 C	Sndrlnd.
Scott, Robert ...	2 C	Leith.
Fairbairn, W. R.	2 C	Lvrpl.
Evans, Edward	2 C	do.
Roberts, John ...	2 C	do.
Murphy, L. ...	2 C	do.
Boyle, Hugh ...	1 C	do.
Walls, Peter ...	1 C	Lvrpool.
Willis, Frederick	1 C	do.
Blackbean, J. J.	2 C	Aberdn.
Mitchell, James	2 C	do.
Bisset, John ...	2 C	do.
Bosestow, George	1 C	London.
Minto, John ...	2 C	Sndrlnd.
Doxford, Jacob	2 C	do.
Murray, W. J. ...	2 C	do.
Taylor, Gabriel ...	2 C	do.
Robson, William	2 C	do.
Dawson, James	1 C	do.
Wilson, Edward	1 C	do.
Mace, Andrew H.	2 C	London
Jeff, James ...	2 C	do.
Anderson, John	2 C	do.
Holman, Thomas	2 C	do.
Pollock, W. C.	2 C	do.
Nixon, Isaac ...	2 C	N Shlds.
Boak, John ...	2 C	do.
Milburn, Wm. ...	1 C	do.
Dixon, Arthur ...	1 C	do.
Carr, Mark W.	1 C	do.
Andrews, Ebenzr.	1 C	London.
Nosworthy, R. H.	1 C	do.
Kerfoot, James	1 C	do.
Neasham, Thos.	1 C	Lvrpl.
Taylor, T. H. ...	2 C	Shmptn.
Soutar, C. C. ...	2 C	London.
Lamb, W. J. ...	2 C	Hull.
Atcheson, Wm.	2 C	do.
Hinchcliff, Wm.	2 C	do.
Campbell, Thos.	1 C	do.

ROBERT JACKSON, Registrar-General,
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

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All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

The Marine Engineer,

LONDON, NOVEMBER 1, 1880.

EDITORIAL NOTES.

THE Admiralty has recently issued a circular addressed to all "Commanders-in-Chief, Captains, Commanders, and Commanding officers of Her Majesty's ships and vessels," with reference to the care and examination of boilers. It would at least appear to us that the commanders-in-chief, captains, and commanders have very little to do with such matters, and that if the circular is meant for the attention of Her Majesty's engineers, it would have been but complimentary to them to have said so. The substance of the circular is to draw attention to the fact that the boilers of some of Her Majesty's ships when examined after paying off, have been found much more decayed than could have been expected from the reports received from the ships during their commission, or than the length of the service justified. They have therefore "caused special enquiry to be made into several of the cases, and after a careful investigation, my Lords are of opinion that the engineer officers in charge of the boilers in question were greatly to blame for not having ascertained the extent of the corrosion which was going on, and for not taking steps to arrest it." Should such corrosion as complained of really have occurred, in the course of ordinary work, it does not seem to have occurred to my Lords that internal corrosion when once set going is not an easy thing to prevent. We should suggest, however, that the most useful circular in such a case would be to have a few of the late issues of THE MARINE ENGINEER, containing the valuable experience and suggestions of our correspondents upon this subject. We think, however, that as the ordinary life-time of the boilers in Her Majesty's service, at any rate in a large number of instances quoted, is much shorter than in the mercantile marine, we must look for the cause in some different conditions of treatment to the boilers in the two services. As we must confess ourselves unable to point out any radical distinction of treatment during active service, we must respectfully beg to differ from my Lords that the deterioration complained of can be laid to the charge of want of attention of the engineer officers whilst in commission. We think the matter has an explanation in the different treatment accorded to the boilers of Her Majesty's service, and of a well-regulated merchant steamer when laid up. In the former case when one of Her Majesty's ships is put out of commission, her boilers are carefully emptied, and left damp to the full action of the oxidizing atmosphere for many months, or even years. Now it must be remembered that it is not water, but the oxygen of the atmosphere that is the most powerful producer of rust. Now the very opposite rule is observed in the Merchant Service. The boilers are kept as full as possible of water whilst standing, so as most effectually to exclude the air, and a life of ten or fifteen years is by no means exceptional for boilers so treated. If the Lords of the Admiralty would have only favoured us or the public with particulars as to the character of the corrosions referred to, whether due to rust, scale, or apparent galvanic pitting, and also whether the final report as to sea-worthiness was given immediately when put out of commission, or as we rather imagine before being re-commissioned, we might have been able through our readers to have given some good practical advice.

THE *Livadia* has proved to be a success, as we before anticipated. Many doubts were stated by practical men as to the possibility of such new lines conferring upon her even a moderate speed. Our course of reasoning was a simple one from nature, and may generally be relied upon as a correct one to follow. If the turbot, as is well known, is amongst the swiftest of our fish, that fact supplies an excellent anticipation of small water resistance from a hull approximating to its lines. Our aquatic birds, such as ducks and swans, are also by no means slow sailors when their limited means of propulsion are considered. And in their submerged shape again is to be found for the lines of the *Livadia*. It is foolishly, as we think, anticipated in some quarters, that the *Livadia* will cease to appear in her character of a pleasure yacht as soon as she reaches Russian waters. We do not think that those holding such anticipations are acquainted, or at any rate are capable of forming an opinion upon the general weakness and unfitness of the plates of the hull of the *Livadia* for resisting the impact of heavy shot. She is built essentially as light as possible for the smallest draught for river navigation. Nor do we think that all the expensive saloons and fittings of the palatial saloons are to be ruthlessly swept away to make room for a battery as soon as she is in Russian waters. There is no doubt as in the case of former Czar's yachts, that in the event of war all considerations would be subordinated to that of patriotic resistance, but we do not think that there is any *arrière pensée* in the *Livadia* other than that she is an experimental test for possible powerful floating batteries to be built hereafter on her lines.

As there is much discussion at the present time as to the relative efficiencies of the European navies, it may be well worth the while for those interested in the subject to peruse a work entitled the "War Ships and Navies of the World," just published by Messrs. E. & F. N. Spon, and written by Mr. J. W. King, an engineer of great eminence in the United States Navy. This volume certainly is a most valuable mass of information upon the number, arming, and character of every navy in the world. England's position may there be seen at a glance, and still affords matter of congratulation to ourselves that we are well to the front. Perhaps the condition of the United States Navy as representing what should be a great naval power offers most matter for wonder. It consists of fourteen old and worthless monitors which are from fifteen to eighteen years old, with armour too thin to be regarded now-a-days as armour at all, and a speed which would scarce suffice to stem a moderate tide. However formidable these may have been in the days of the Merrimac and the old wooden walls, they are but disreputable representatives even against such puny adversaries as the South American Republics. Besides these monitors and the wooden vessels all of which are of lower speed than our ordinary commercial liners there are besides but six ironclads of no great speed or power, five of which are in various stages of suspension and neglect. It looks as if Uncle Sam is so eager to pay off his debt, and do the thing cheap, that he is neglecting that usual form of marine insurance—a powerful navy.

MR. KING brings one serious charge against the British Navy which we certainly hesitate to accept. He infers that the trial trips of the ironclads of our Navy are more or less factitious in their registered speeds. Not that he doubts that such results have been actually obtained at the trials, but that similar speeds cannot be obtained under ordinary circumstances. He has alleged that by the testimony of the captains of the *Vanguard* and *Iron Duke*, the former never exceeded at sea a speed of 9 knots, and the latter a speed of 10½ knots. This is a falling off of nearly 6 knots in the one, and 3½ knots in the other. We think this is trying to prove too much, and bears its refutation on the face of it. Either the opinions of the captains in question have been misunderstood, and thus misrepresented, or else have been very loosely expressed. Or a third supposition may just possibly be that the estimates of practical speeds so expressed can only have been in unusual conditions of foulness of bottoms, bad fuel, and, possibly, low boiler pressures. None of these conditions would, we are sure, warrant the conclusion that the test trials of our ironclads are under bogus conditions, or that, by proper attention, they could not be made at any time to nearly approximate to those speeds in smooth water. We should be glad to receive practical confirmation on these points from any of our readers of Her Majesty's Service.

THE Yankees have again been before us with an invention that promises to be a great security to all sailing pleasure boats. This is a class of boat peculiarly liable to disaster on our gusty lakes, rivers, and seaboards, particularly when they are so often handled by totally inexperienced sailors. We were much interested in the account, just come to hand from America, of the personal experience of the writer, in an especially crank sailing boat, provided with newly-invented safety apparatus. He first premises that he would on no account have ventured into the crank-looking craft on such a gusty day, without he had been a good swimmer, and provided with means of support in the water if overset. The spread of canvas hoisted was very large, sufficient to cause the boat to drive very rapidly through the water. No sooner had the boat passed seawards an obstructing promontory, in the partial lee of which they had up to that time been sailing, than the suddenly increased force of the wind pressed down the sails and mast almost level with the water, *but the boat itself still remained on a nearly even keel*. The first impression of our informant was that the mast had very fortunately gone by the board, but as the boat was brought up more to the wind the mast rose again to the perpendicular, and gave way again only in proportion as the wind pressure increased unduly. When, also, the boat was put about nearly before the wind, and was driving at such a speed that under ordinary circumstances she would have buried her nose in each succeeding wave, as she flew from one to the other, it was observed with much wonder on the part of the novice that she rose easily to each wave by the pitching being confined to the hull alone, and not carrying with it in the rise the whole area of sail against the wind pressure. These most astounding results were effected by the peculiar fitting of the mast, which was stepped in a ball joint, and only retained in its vertical positions by strong spiral springs fore and aft, and thwart ship. This gave as much power of play between the boat and its mast as there is between a well-hung carriage and its wheels. The abrupt pitching of the boat was comparatively independent of the sail pressure, and she was therefore as lively in her rise as a row boat. The sudden gust of wind depressing the mast and sail had little leverage upon the hull of the body, as the spiral springs are attached low down on the bottom flooring. We think this a very important invention, and likely to as much affect the action of sailing boats in a chopping sea and gusty wind as springs affect the riding of the body of a coach over a rough road, only the conditions are reversed. The hull of the boat in this case is the wheels of a coach, which are to be allowed the freest motion possible, independent of the body.

A NEWCASTLE firm has contracted with Messrs. Palmer & Co., at Jarrow, to build a large steamer for the East India trade.

OBSERVATIONS ON CERTAIN EXPERIMENTS TO DETERMINE THE FRICTION IN PROPELLER SHAFT OF SCREW SHIPS.

IT has frequently been the practice at the principal dockyards in England, to ascertain from time to time the condition of the shaft bearings, as to friction, of nearly all Her Majesty's ships when in dock, by simply suspending a weight at some part of the propeller-blade just sufficient to induce motion. We take it for granted that in all these tests the proper caution is taken to free the results, as far as practicable, from the additional and irregular resistance due to the *quiescent condition*.

We have no information as to how the *data* thus variously obtained is collated or turned to account; but assume that, taken in connection with the radius and weight of shaft and screw is relied on, more or less, as affording evidence of the condition of the bearing, and the amount of friction they offer. Many considerations are, however, involved in a question of this sort, that suggest much caution before we rely on a test of this description as affording any *data* of sufficient value for comparison. The general theoretical view of this mode may perhaps best be illustrated by reference to the well-known diagram in mechanics here subjoined.

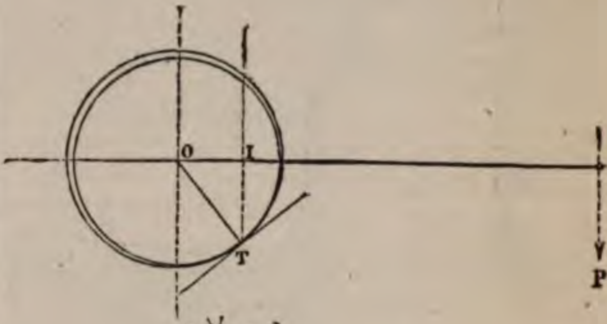


Fig 1

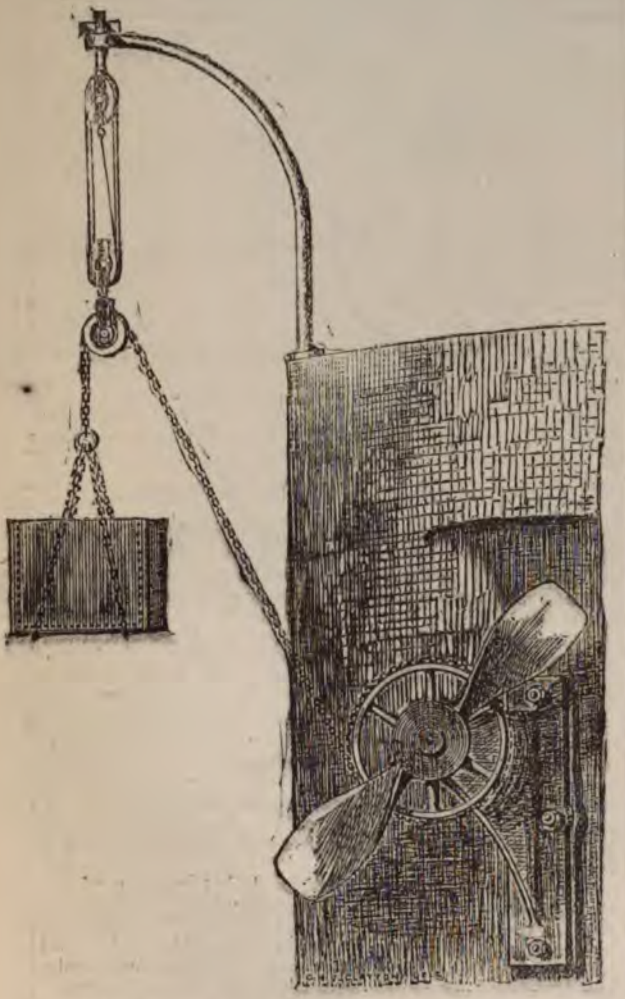
In which it is assumed that the weight of shaft, &c., acts through its centre of gravity, O, and the resultant of all the forces acts at T. But the generally admitted difficulty arising from the theory of static resistance, as applied to a body so unsymmetrical, in which the centre of gravity is so indeterminate, in addition to the characteristic immobility of a shaft, or axle, of any magnitude, render the problem so far difficult in its theoretical aspect. There are other circumstances and conditions of a perhaps more important character, incidental to a test of this sort while in dock, to which we shall subsequently refer, but their practical effect is such as will be seen, is sufficient to discredit generally such a practice to determine the resistance offered by friction when afloat, or the ship in its natural condition. Having thus briefly referred to the measures which have hitherto only been adopted, and the theoretical and practical difficulties to which they are subject, we may as concisely as possible introduce the circumstances and experiments forming the subject of this paper.

One of H.M. ships was placed in dock to make good general defects, part of which consisted of a report from the officers of the ship, to the effect that the "Port screw would not revolve when under sail at a speed of ship, less than nine knots, and the prejudicial effect this stiffness in the shaft had on the performance of the ship on her competitive trials with other ships of her class."

Before "drawing" the shaft, recourse was had to the test referred to, *i.e.*, hanging a weight to a shackle, on the blade of screw, 7 ft. 7 in. from centre of shaft, when it was found to require a weight of 2252 lbs. to just induce motion. The screw was then removed, and the shaft drawn out of the stern tube. The shaft showed indications of *hard bearing* at the centre bearing (not very usual to have this centre bearing in stern tube), which caused it to act as a constant brake on the shaft. This irregularity was adjusted, the screw and shaft replaced, and on again applying the weight test it was found to move with a weight of only 502 lbs. at the same radius of lever. Both of the above-named trials—*i.e.* before and after adjusting the shaft—were severally repeated with the same result, and with the packing removed from stuffing box, in stern tube, and oil forced into the bearings. The starboard shaft was similarly treated, and after its adjustment moved with even a less weight than the port shaft. The history of the testing which had been made in England, shows that the ship's recent steaming had effected some improvement, and the adjustment now made will completely relieve the bearings of that brake influence, and make considerable improvement in the ship's future performance.

The engineer and other officers responsible for repairs, &c., were at once impressed with the desirability of connecting the result of this test with the amount of friction exhibited when rotating—as under sail—and thus obtain definitely the dynamical units of resistance; and, as it was evident no straining effect in the ship, or other impeding *brake* influence, now existed, it was regarded as a favourable opportunity for making the necessary experiments.

The simple and inexpensive mode given in accompanying sketch was adopted, which will be seen consisted of a pulley, or drum attached to the end of screw shaft; round the drum was a chain which led through a leading block at the end of boat's hoisting tackle at boat's davit, and secured to a 1-ton water tank, which acted most conveniently as an adjustable "falling weight."



Two modes of operating were adopted. The first mode consisted in carefully pumping water into the tank, until motion was just perceptible, and noting the time of falling, the distance or space fallen through, and the gross *weight* of tank and contained water.

In the other mode of operating the screw was *held fast* by a line to the blade, and in these experiments the tank was loaded to what was known would be a preponderating extent, and which would start the shaft into rotation with some velocity the moment it was released from the line at the blade, the object being to compare the effect of velocity on the co-efficient of friction.

DATA OBSERVED WITH A DESCENDING WEIGHT.

EXPERIMENTS.			*S*	*T*	*W*	REMARKS.
No. of Experiments.	Condition of Gland Packing.	Date.	Observed height of face.	Observed time of falling.	Total Weight of falling body.	
			Feet.	Scnds.	lbs.	
1 & 2	Not Packed.	1872. 20 Dec.	25·0	12	1504	Mean of 1st and 2nd Experiments.
3		"	24·91	18½	1574	Some time before starting.
4		30 Dec.	33·66	21	1273	Good and reliable result.
5		"	33·50	15	1466	"
6		"	33·66	47	1123	Minimum weight and lowest velocity.
7		"	21·75	9½	1530	Preponderating weight.
8		"	20·05	9	1530	
9	Packed.	1873. 3 Jan.	28·50	21	1637	The effect of packing Stern Gland is here shown by the additional weight required to start the shaft into rotation.
10		"	29·75	15	1615	
11		"	20·00	6	1765	Preponderating weight.
12	Ship Afloat.	"	22·75	10	1830	Afloat in usual trim. The weight hung at first until the chain was shaken.

The weight above given is the "Total gross weight," in which no account is taken of the friction due to the chain passing through the "leading block." From observations with the same amount of weight, it was found that the "modulus" of that pulley was equal ·92, therefore in dealing with these weights in our subsequent investigations, they will be reduced to that extent, and regarded thus as "Effective weights."

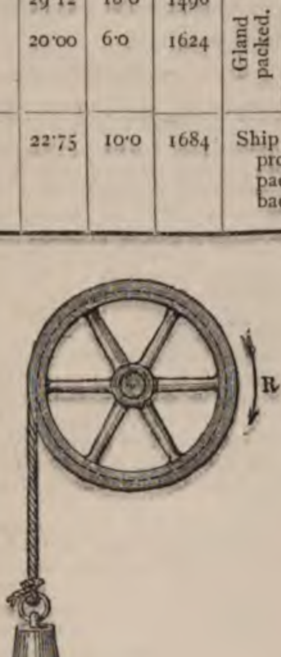
For the purpose of comparing the result of these experiments, it will be sufficient to divide them into groups as a fair and impartial exposition of the separate effect of each of the social conditions under which they were made. Thus the first six represent the condition of lowest attainable velocity, and Gland *not* packed, and experiments 7 and 8 show the effect of increasing the velocity only.

Experiments 9 and 10, when compared with experiment 11, show the effect again of increased velocity, when the Gland is newly packed (but not tightly screwed); and the single experiment No. 12 will serve to connect the entire set with the case, as when the ship is in her normal condition and trim, afloat. While experiments 1 to 8 show when compared with the average of 9, 10, and 11, the effect of packing only.

Then reducing the gross weight to effective weight, and taking the average of the separate groups for new average data as just proposed.

The result will now stand thus :—

New Initial Letter.	Corresponding number of Experiments in former Table.	*S* Mean space fallen through.	*T* Mean observed time in descending.	*W* Mean reduced effective weight.	REMARKS.	
	No.	Feet.	Scnds.			
A	1 to 6 inclus.	30·55	22·7	1277	Gland *not* Packed.	Slowest velocity.
B	7 and 8	20·90	9·25	1407		Preponderating weight, and higher velocity.
C	9 and 10	29·12	18·0	1496	Gland packed.	Slowest velocity.
D	11	20·00	6·0	1624		Preponderating weight, and higher velocity.
E	12	22·75	10·0	1684	Ship afloat, and in proper trim. Gland packed, but eased back.	



Having thus eliminated friction due to the leading pulley, the question becomes in all respects analogous to the wheel and axle problem (as per Fig.) with a descending weight W, and the resistance (R) is made up of the Friction in the journals, and the Inertia of the shaft and propellor.

While the work *usefully* done to overcome those resistances is the total work applied as represented by the descending weight multiplied by the space S, *minus* the work accumulated in the descending weight, we shall therefore proceed to estimate these respective forces, and bring them to account in a tabulated form.

It will not be desirable in a paper of this sort to attempt any demonstration of the rules or formula adopted, but content ourselves with referring to such works as "Tate's Mechanical Philosophy" (and others) for that purpose.

Observing that with a view to a more concise view of the result, we shall in all cases express the *work* done in terms of UNITS *per second.*

Now the work accumulated in a descending weight, at the end of any time—t—is equal to the work done in raising the same weight the height it would require to fall to acquire the same velocity, and which is expressed by symbols.

Thus s = space or height, = $\frac{v^2}{2g}$, were v = velocity acquired.

And let w = weight of descending body
t = time descending.
u = units of work per second.

Then as $\frac{v^2}{2g}$ w = Total work accumulated.

$\therefore u = \frac{v^2 \times w}{2g \times t}$ = Units of work accumulated per second.

Then, referring to Data in Table of Experiments on this page, and to initial letter—E—for acquired velocity, weight and time, we have $\frac{4{\cdot}55^2 \times 1684}{64{\cdot}4 \times 10} = 54$ = Units of work accumulated per second in descending weight.

It would not have been necessary to calculate the work accumulated in shaft and propeller, had we observed at the time the entire space passed over by the circumference of the shaft both during and after the weight was descending, and acting as the moving force. Then this total space multiplied by the weight of shaft and propeller would represent the total work due to friction. However, in these experiments this was omitted being done, and we must therefore calculate the work accumulated in shaft and propeller at the moment the descending weight ceased to act. When the centre of gyration is known this work can readily be calculated, but our data, whereby to calculate the centre of gyration, is not so exact as could be wished. The weight of shaft, by the "book of weights," is a little over 4 tons, and to obtain the other weights measurements only have to be relied on, and their value in annexed form is the best we can furnish as an *Approximation.*

APPROXIMATE WEIGHTS AND RADIUS.

Denomination.	Shaft.	Propeller Boss. Coupling and end of Shaft.	Propeller Blades. Four in No.
Radius - - - feet	·54	1·25	8·—1·25
Weight - - - - lbs.	9000	7500	8900
Calculated Radius of feet. Centre of Gyration - - - -	·38	·9	5·7

Then common centre of gyration for shaft and propeller is

$$\frac{(\cdot 38 \times 9000) + (\cdot 9 \times 7500) + (5{\cdot}7 \times 8900)}{9000 + 7500 + 8900} = 2{\cdot}4$$

and the velocity ratio of this centre to the velocity of descending weight is

$$\frac{\text{Radius of centre gyration}}{\text{Radius of Drum}} = \frac{2{\cdot}4}{3{\cdot}13} = \cdot 766$$

Similarly velocity ratio of Shaft Journal $= \frac{\cdot 54}{3{\cdot}13} = \cdot 172.$

Then for work accumulated in shaft and propeller, when SP = their weight, and v = acquired velocity at end of time—t—we have

$$\frac{(v \times \cdot 766)^2 \times SP}{2\ g} = \left\{ \begin{array}{l} \text{Total work accumulated in shaft} \\ \text{and propeller at end of time—t—} \end{array} \right.$$

and taking data from E on this page we have

$\frac{(4{\cdot}55 \times \cdot 766)^2 \times 25400}{64{\cdot}4 \times 10} = 476$ = units of work accumulated in one second in shaft and propeller.

"INVINCIBLE."

TOTAL WEIGHT, SHAFT AND PROPELLER :—25,400 lbs.

TABULATED RESULTS OF EXPERIMENTS.

Work expressed in Units per second.

Initial Letter.	*W* Effective Weight.	*S* Space or Height of Fall.	*T* Mean of observed Time in falling through s—space.	*V* Velocity acquired at end of time —t— V = 2 g	Total work per second. w × s ÷ t
	lbs.	Feet.	Seconds	Feet	Units
A	1227	30·55	22·7	2·69	1650
B	1407	20·90	9·25	4·50	3166
C	1496	29·12	18·0	3·23	2419
D	1624	20·00	6·0	6·66	5412
E	1684	22·75	10·0	4·55	3831

Initial Letter.	Accumulated Work to be Deducted.		*U* Nett Units of Work expended in Friction.	*F* Weight of Shaft, &c., multiplied by Angular Velocity of Shaft Journal per second.	Co-efficient of Friction.
	In Descending Weight.	In Rotating Shaft and Propeller.			
	Units.	Units.	Units.	$\frac{25400 \times {\cdot}766v}{t}$	U + F
A	6	73	1571	5877	·267
B	49	506	2611	9830	·265
C	14	134	2271	7056	·321
D	170	1710	3532	14536	·243
E	54	476	3300	9992	·330

The short formula given at the different headings in foregoing tables will sufficiently indicate how those respective quantities are obtained in all such cases that have not previously been worked out by an illustrative example.

The general coincidence in the resulting "Coefficient of Friction" is what might be expected, as in every trial there was the most perfect assurance that the shaft was in all respects free to revolve, and all the bearings were in as good condition as possible.

There are various other points which suggest comparison and remark which we shall defer discussing until we make our concluding remarks, except the interest that naturally attached to the future performance of the *Invincible* more especially to note *the speed of ship at which the screw will now revolve*, and thus be enabled to make further investigations in a somewhat reverse order to the preceding. As for instance, we are told the screw would not revolve under a speed of ship of nine knots. Now if we turn this speed of ship into the corresponding pressure per square foot it would produce on the blades of the screw and again resolve that pressure (which is then acting in the direction of the keel) into the direction of the screw's plane of rotation, it will give us the pressure per square foot on blade of screw tending to turn it round; then if this unit of pressure is multiplied by the area of blades, and again by the radius of the centre of effort at which the whole pressure may be supposed to act, we shall have the pressure in foot, tending to turn the screw.

For example:—a speed of nine knots per hour $= \frac{9 \times 6080}{60 \times 60} = 15{\cdot}2$ feet per second, and taking a cubic foot of sea water to w eigh 64·2 lbs., the pressure which would be brought to bear on a plane of = a = area —at right angles to the direction of the ship, and the ship moving with the velocity here given (15·2 feet per second) would be expressed thus:—where ($2g = 64{\cdot}4$)— $\frac{15{\cdot}2^2 \times a \times 64{\cdot}2}{64{\cdot}4}$ = total pressure on plane, and which for our purpose may be written—thus —$15{\cdot}2^2 \times$ area = pressure on plane.

The actual area of each blade of *Invincible* is about 13 square ft., and if we assign an empirical value, as effective area, *i.e.*, area at right angles to avis, which in ordinary blades would equal actual area multiplied by nat. cosine of angle of screw. The *Invincible* has a Magin Screw, one blade placed before the other, therefore we may assign an effective area (in the above sense) to both sets of blades of 30 square ft.

Let us further assume that the centre of effort acts at a radius of 6 ft. from centre of shaft, then we have $15{\cdot}2^2 \times 30 \times 6 = 41580$ as the total pressure in foot lbs. on the surface of screw, and the ratio of this pressure to *turn* the screw is equal to ratio of circumference to pitch, or $\frac{\text{pitch}}{\text{circum.}} = {\cdot}41$ then $41580 \times {\cdot}41 = 17047$ = foot lbs. required to turn the screw in its axis. Now if we turn to the record of what was actually required when first docked, we find it took 2252 lbs. at a radius of 7 ft. 7 in. (page 171) which is equal to 17077 foot lbs., this near approach in result seems to confirm the correctness of the above assigned value for the compound quantity area of blade × centre of effort, as an approximation sufficient for further application. Therefore, again assuming this same quantity, 180, let us apply it to determine at *what speed of ship* the screw will now *commence* to revolve, *i.e.*, since its adjustment of bearings has been effected, and taking the weight at which screw revolved in (E) experiment (page 173), then we have $1684 \times \overset{\text{radius of drum}}{3{\cdot}13} = 5270$ foot lbs. at the turning force required; then dividing this by $\frac{\text{pitch}}{\text{circum.}}$ ratio, and the compound quantity, area × centre of effort we have $\frac{5270}{{\cdot}41 \times 180} = 71{\cdot}42$ which is equal to the square of the velocity, at which the ship must move per second, then $\frac{(71{\cdot}42)^{\frac{1}{2}} \times 60 \times 60}{6080} = 5$ knots the rate per hour at which the ship must move through the water before the screw will *commence* to revolve.

Observing that after the packing has worn down, probably it will commence at a trifling lower rate of speed, the packing was quite new in experiment E, and we have shown the considerable improvement that may be expected from continued use and repetition; it is a well observed fact in reference to screws revolving, the difference in speed of ship at which they will commence to revolve, as compared with the speed of ship, at which they leave off revolving, and which is often very considerable.

Now if we turn to the case of the *Northumberland*, the dimensions of her "screw blades" four in number are, mean breadth, 4·65 ft. (practical) length 9 ft.
then $4{\cdot}65 \times 4 \times 9 = 167{\cdot}4$ = total area, (angle of screw = 17) and, $167{\cdot}4 \times \cos \angle 17° = 160$ = effective area.

Let us for radius of centre of effort = 9 ft. and ratio of $\frac{\text{pitch}}{\text{circum.}} = {\cdot}31$ and when the ship makes 4 knots the screw starts into rotation.

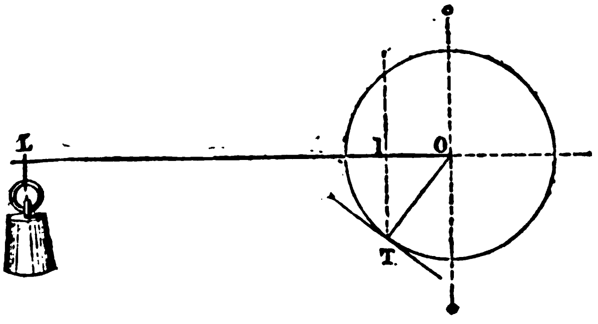
then $\left(\frac{4 \times 6080}{60 \times 60}\right)^2 \times 160 \times {\cdot}31 = 2262$ lbs. of turning force acting at a radius of 9 ft. from centre, and which is equal to an angle of resistance of 14° 30′ or a co-efficient of friction = ·260.

The foregoing is only at best a convenient approximation of the circumstances, but it suggests the desirability of obtaining certain further information, and data, that may be turned to profitable account. Reverting to the mode of *Testing Screw Shaft*, by suspending a weight at some part of propeller blade, sufficient to just induce motion, and the considerations we briefly pointed out as involved in the question. Our object is not, however, to dwell on any of the nicer theoretical difficulties, but to *insist* on the more frequent, and it appears far more important, obstacles, which embarrass the conditions essential to practical value in an experimental test, conducted as this is. We refer now more particularly to the effect of docking and shoring, in producing sufficient strain or deflection in that part of the ship, and which acts as a very considerable "*brake*" on the shaft. This is no fancy view of the matter, it has occurred more or less in every ship of any size that has yet been tried, and the obvious objections to interference with the *shores* of a ship in dock makes it difficult to see in what direction to apply any remedy.

The *Northumberland*, recently in dock, furnishes a graphic and instructive illustration of the condition to which we are directing attention. In three trial "tests" following immediately each other, it required 91 cwt., 64 cwt. and 61 cwt. respectively at a radius of lever 11 ft. from centre, to move the shaft. When 20 cwt. would have been ample had the shaft been as free to revolve as when the ship is afloat; previous to the above trials the packing had been drawn from the stern gland, oil was injected into the stern tube and the shaft was previously moved round by the "turning gear," so that the cause of this *brake* influence was clearly due to deflection and docking.

And we may reasonably pause to inquire, when can we feel assured that no such influence is at work to damage the reliability of the data we may obtain.

An incident in test trial of the *Growler*, very recently made, is deserving of mention, as further exhibiting the effects of "overshoring." On the first test being applied it required 344 lbs. to move the shaft, but on a contiguous "shore" being removed, the shaft readily moved with 224 lbs. applied at the same radius of lever.



SCREW SHAFT EXPERIMENTS.

Various Ships, both in Dock and Afloat, to determine Co-efficient of Friction.

DETAILS.						In Dry Dock.		
		Invincible, *400 h.p.*	*Research,* *200 h.p.*	*Cockatrice,* *60 h.p.*	*Wizard,* *60 h.p.*	*Invincible.*	*Wizard.*	*Cockatrice.*
		Single Trial.	Mean of Six.	Mean of Five.	Mean of Three.	Mean of Ten.	Mean of Three.	Mean of Three.
Weight,	Propeller	16000	4928	896	896	16000	896	896
,,	Shaft	9400	13888	1640	2784	9400	1640	1640
,,	Total	25400	18816	2536	3680	25400	2536	2536
Radius.	Pulley to which weight is attached	3·13	2·0	1·1875	0·605	3·13	0·365	1·1875
	Centre of Gyration	2·4	1·2	0·71	0·70	2·4	0 71	0·71
	Shaft Journal	0·54	0·36	0 198	0·198	0·54	0·198	0·198
Observed Data.	Effective Descending Weight	1684	1106	141	365	1390	446	170
	Height of Fall	22·75	11·116	10·0	10·0	26·86	3·4	10·0
	Time of Falling	10·c0	7·66	5·95	7·1	16·65	14·0	3.5
Acquired velocity— $v = \frac{2s}{t}$		4·55	2·90	3·35	2·816	3·22	0·476	5·7
Total applied work, per second w.s. ÷ t		3831	1604	236	514	2242	106	486
Deductions for Work NOT expended in Friction.	Accumulated in descending weight	54	19	4	6	13	—	25
	Accumulated in rotating shaft and propeller	476	49	28	84	144	24	132
Nett units work due to friction		3300	1536	204	424	2085	82	329
Velocity Ratios.	Gyration, centre	·766	·60	·60	1·15	·766	1·945	·60
	Periphery { Shaft Journal	·172	·180	·167	·308	·172	·542	·167
Weight of shaft + $\frac{6}{7}$ Propeller × space passed over per second, by Periphery Journal		9992	4709	675	1634	7046	320	1209
Co-efficient friction		·330	·326	·302	·260	·296	·260	273

Other instances of the same type could be furnished. But we will assume that in the future trials for making this test all objectionable conditions will be obviated, when the following investigation will serve to illustrate the rule applicable to the case.

Now let S = weight of Shaft and Propeller.
P = weight applied at L.
L = distance $\overline{\mathrm{L\,O}}$.
a = „ $\overline{\mathrm{I\,O}}$.
r = radius of Shaft $\overline{\mathrm{O\,T}}$.
f = co-efficient of Friction.

Then total weight acting through centre of gravity, o, o, = S + P, and its pressure at T = (S + P). r. cos ∠OTI.

Moments of friction about T = f· (S + P). r. cos $\overline{\mathrm{I\,T}}$, but f. cos ∠OTI = sin θ nearly, and r. sin θ = a.

Then substituting A (S + P) = moments of friction, which by equality must = P (L—a).

(1) ∴ r. sin θ (S + 2P) = PL when P acts downwards.

Similarly r. sin θ (S — P) = PL when P acts upwards.

The value of f may be obtained by taking from table of Natural Tangent the Tangent ∠OTI, corresponding to same angle as sin θ above.

The value for sin θ we have given differs from that usually given, because they appear always to regard the question as in a condition "*bordering* on motion." But we cannot, in a case of this sort, recognize practically a condition of "bordering" on motion. P *must* preponderate, and motion *must* ensue as a necessary result of the *test*, and it is therefore evident that the resultant must cut the circumference at an angle *greater* than the limiting angle of resistance.

DATA AND RESULT OF "WEIGHT TEST" ON SCREW BLADES.

	S	*P*	*L*	*R*	∠OTI	
Ship's Name.	Weight of Propeller & Shaft.	Applied Weight.	Radius of Lever. $\overline{\mathrm{L\ o}}$	Radius of Shaft.	Angle of Resistance.	Sin θ
	cwt.	cwt.	Feet	Feet		
Northumberland	923	61·0	11·0	·75	58½°	·855
Lord Warden	765·5	36·1	11·1	·968	29½°	·492
Research	168	3·0	5·5	·36	15¼°	·263
Invincible	226 78	4·48	7·58	·54	16°	·273
Growler Starbd.	43·63	2·0	2·625	·4375	15¼°	·263
Growler Port	49·20				13½°	·234
Pallas	374	20.	7 66	·75	18°	·310
Wizard	22·678	·332	3·0	·198	12¼°	·215
*Cockatrice	22·678	·600	3·0	·198	22°	·380

The most significant teaching to be derived from these experiments is the extreme caution necessary before relying on the result of any "test trial" made while the ship is in dock. We have sufficiently pointed out the extreme liability to strain and deflexion under such conditions, and this in connection with the dissimilar condition of the bearings generally, distinctly point to the necessity of confining "test trials" of this sort to when the *ship is afloat.* The *Invincible, Research, Wizard,* and *Cockatrice* were each *tested* most effectively when *afloat*—the three last-named ships without difficulty, expense, or any special contrivance beyond the usual means to be found in every ship. And there is little doubt but some similar means can always be extemporized to suit the peculiar case of every ship. It is, we think, most desirable to continue these experiments throughout the service both generally and periodically—generally that we may obtain a wider basis of data and observation. At present no *data* is extant of experiments with bearings of the mixed character, or at an insistent pressure per unit (of surface) at all corresponding to what we find in screw shafts, where the pressure ranges from 60 to 120 lbs. (or more) per square inch, and the bearings consist of metal and Lignumvitæ, of metal and metal with hemp packing, and iron and white metal. Morin's experiments on axle friction were made at an insistent pressure per square inch ranging from 14 to 28 lbs. only, and each bearing in the axle, similar in the character of its surface—while Rennie, after a preliminary experiment at 32 lbs. seems to have gone direct at one leap to experiments commencing at about 190 lbs. insistent pressure per square inch. And therefore, as Professor Moseley (*Engineering*, p. 142) points out, the limit we seek as applicable to screw shafts "is lost in the intervening chasm" which lies between those limits. Periodically at suitable intervals because we know that the amount of resistance in the shaft is affected differently in different ships, and under certain different conditions in the same ship by time and wear, sometimes getting less, and not unfrequently getting worse by wear or other change. The *Invincible* had evidently improved from the time she was tested at Devonport in July to the time she was tested at Malta in November, 1872, having steamed considerably during that interval. While on the other hand we may refer to the *Hurcules*. When this ship was on her first trials it was found that the screw and shaft would revolve when the ship was making about 5½ knots under sail. But after some two years of pretty constant work, both under steam and sail, it was found that the screw would not start into rotation, under a less speed than about 7 knots. We could, if it was requisite, multiply instances both of improvement and the contrary effect; therefore it is we desire a record of a larger number of observed facts, to derive the full benefit of their teaching.

In reference to any future experiment with a descending weight to obtain the friction, we have already suggested the advantage it would be to obtain at the time a measure of the entire space passed over by circumference of axle journal, (in addition to the space and time of descending weight) indeed the first project as to these experiments was that they should in their character be a modification of "Atwood's Machine" and then the respective data we should have obtained would enable us to calculate the result as to co-efficient of friction without the complexity of considering the centre of gyration.

It will have been observed by reference to "Table of Results" that the friction becomes somewhat less in proportion as the velocity is increased. M. Bossut, we believe, first drew attention to the fact, and in a memoir to the Paris Academy of Science he gives also an empirical formula to connect the two relations.

We may mention in reference to the advisability of making or repeating the same experiment several times, that if we take the case of the *Research* the *average* of five trials gives a co-efficient of of friction = ·326, but let us discard the two first trials, then the data of the last three trials would give a co-efficient = ·269, and this circumstance should be duly considered, in looking at the resulting co-efficient the single trial (E) of *Invincible* furnishes; the ship was just out of dock and the gland new packed, there is therefore every presumption that had the experiment been repeated, a corresponding reduction in co-efficient of friction would have been exhibited.

In all the foregoing paper we have adopted the "Step by Step" form, both in statement and investigation, in the hope of its being more generally useful to naval engineers, to whom we must look for further experiment and data on this subject; and if error of calculation, or even of thought, should have become mixed in this paper, we hope this simple arrangement will afford facility for applying the correction without materially impairing the character or general view of the question.

THE NEW TORPEDO.—The New York papers give some particulars concerning the invention of Captain John Ericsson of a remarkable engine of Naval warfare, before which iron-armour is rendered practically useless for ships of war. The weight of the projectile including the piston, was 1,281 lb., its diameter 15 in., and its length 19 ft. At its head it carries, as an explosive, a charge of dynamite weighing 250 lb. a cast-iron armature being affixed to the tail in order to balance the weight of the dynamite. It is shaped almost exactly like an enormous cigar. Captain Ericsson says the initial velocity with which his torpedo leaves the gun is at the rate of 160 miles per minute. Of course this cannot long be maintained in such a medium as water. The Captain fires his torpedo with gunpowder. He says that the substitution of powder for compressed air in propelling submerged torpedoes is the most important advance in that science which has recently been made. He computes, from the force of the charge, that there his not an iron ship in existence that could withstand the shock of the explosion of the tremendous dynamite charge with which his cigar-shaped projectile is loaded. The Captain has built at his own expense a vessel which he styles the *Destroyer*, which is intended for the experimental demonstration of the simplicity and power of his invention. He has made many improvements since the trial at Sandy Hook, and within a few weeks will be prepared for another series.

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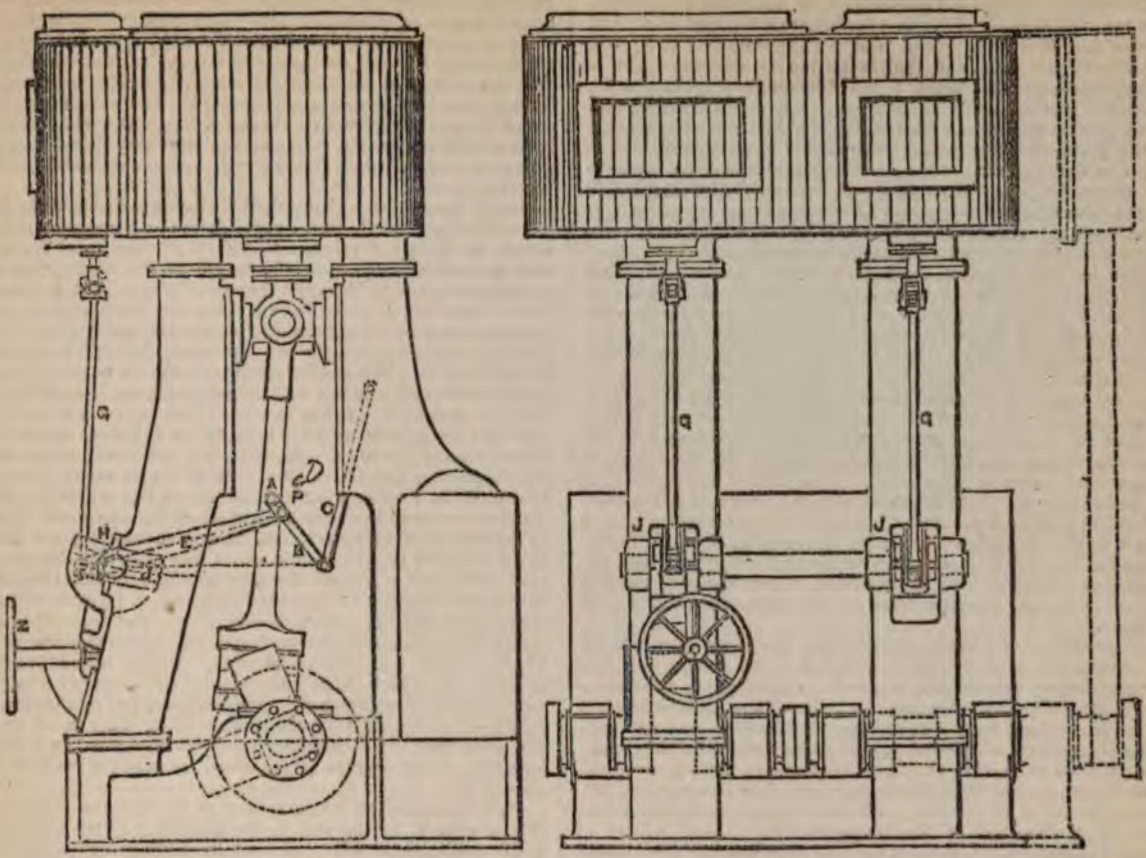
* It has since been discovered that when making above trial, that the collar of after boss was bearing at the bottom. This would increase the distance $\overline{\mathrm{I\ O}}$, and weight P: the angle here given is, therefore, *not* correct; but it shows the effect of such a circumstance.



END VIEW. FRONT VIEW.

The Dotted Lines show the extra room occupied by an engine fitted with Link Motion.

REVERSING AND EXPANSIVE VALVE-GEAR.

ON A NEW REVERSING AND EXPANSIVE VALVE-GEAR.

Paper read before the Institution of Mechanical Engineers at Barrow.

By MR. DAVID JOY, of London.

THE reversing and expansive valve-motion, which is the subject of the present paper, was originally drawn out by the writer in a crude state, but possessing all its present elements, in the year 1868-9; and has since been, at different times, the subject of frequent investigation and experiment on his part. In 1877 he made it a special study, first working it out on paper, and afterwards testing all the movements and positions by means of models. And thus, passing through innumerable forms under the correction of various errors of action, it has ended in the arrangement which is now submitted to the Institution.

In passing, the writer may call attention to the fact, that this is only one of the many instances where inventions are the result of a long course of work, followed in a given and definite direction, and with a special end in view. It thus helps to disprove the theory of opponents of the patent system, who rather characterize inventions as lucky chances, which men of scheming brains fall upon without expecting it. A few such cases do occur, just to give colour to this statement; but even these generally happen to men who have been working laboriously on some kindred subject.

In the writer's case, as an engineer, his attention has been specially directed by circumstances, and, perhaps, partly by taste, to the question of the movement of the valves in steam and other engines. As a pupil at the Railway Foundry, Leeds, he was thoroughly initiated into the mysteries of lead, lap, port, and travel, by the investigation and observation of John Gray's valve-motion as applied to locomotives, the first instance in which expansion was so applied successfully. Those who are familiar with the ingenious details and perfect action of Gray's motion will not be surprised at the strong bias thus given to the writer's mind in this direction; and the conviction was gradually attained by him that the proper distribution of the steam in a steam-engine is the very life and soul of the machine, and that the mechanism for effecting this object cannot receive too careful or too minute attention.

The great complication of Gray's motion and the difficulty of keeping it in order (partly owing to the very perfection and refinement of the action), were no doubt the causes of its falling out of use, and giving place to others more simple though less perfect in their action. These were again finally superseded by the very general adoption of the "Link Motion," now employed almost universally by English and American engineers, and very widely also on the Continent, though with a greater disposition there to depart from established usage. To the "Link Motion" the writer will refer in the following paper as the most satisfactory, because the most generally known, standard of comparison; and by this standard he hopes to show that a distinct advance has been made in the valve-motion now to be described.

The link gear in its turn became the subject of very careful practica analysis by the writer, while he had the charge of the rolling stock of a railway in the Midland counties, where the high price of coke rendered necessary a careful attention to economy of fuel consumption. Here he personally superintended the setting of numbers of valves, worked by link gears of various descriptions and arranged them [illegible] proportions, all with a view of obtain- [illegible] together with an equal lead; but [illegible] the well-known fact that it is [illegible] that in setting for one the other is [illegible] that the inequality increases as the [illegible] high grades of expansion, and with [illegible] the lead becomes so excessive, [illegible] admitted is so considerably in [illegible] that, although the arrange- [illegible] high-speed engines like locomotives, it [illegible] for slow-running types, such as [illegible] these an additional valve and [illegible] employed for expansion.

[illegible] to design marine and other [illegible] the same course, and worked out [illegible] the steam, keeping in view [illegible] desiderata in designing all machinery— [illegible] accuracy. Among the earliest of [illegible] of giving steam to the first piston of a [illegible] manner, and then using this piston [illegible] cylinder, into which it passed [illegible] Afterwards, working in an entirely dif- [illegible] live steam to move the valves, instead [illegible] at all. This plan, though answering [illegible] machines, such as steam ham- [illegible] to give the exact control necessary [illegible] producing a rotary motion. Finally, [illegible] appliances, and using both the [illegible] knowledge of the action [illegible] worked out the valve-gear which is here [illegible]

[illegible] remark that, though on the whole the [illegible] so well and for so many years, yet, [illegible] years, the endeavour to produce a [illegible] than the link, and free from its inherent [illegible] on the Continent, the attention [illegible] is sufficient proof of the impor- [illegible] Prominent among these motions are, [illegible] gear, and that designed by Mr. [illegible] and more recently in England, that [illegible] Newcastle, and that of Mr. Kitson, of [illegible] possible description of these would [illegible] examination it will easily be seen that [illegible] avoid the complication of the double [illegible] as well as the various errors unavoidable in [illegible]

[illegible] valve-motion, it may be premised [illegible] to arrange a suitable valve-gear for [illegible] marine engine, abandoning entirely the [illegible] vertical motion from the air-pump lever, [illegible] motion taken from the vibration of [illegible] this general principle that the valve- [illegible] words, the combination of two motions [illegible] by the various proportions in which [illegible] positions in which the moving parts [illegible] other, gives both the reversal of the [illegible] degrees of expansion required.

[illegible] will at once be understood and followed [illegible] illustration, representing an ordinary overhead [illegible]

[illegible] A is the connecting-rod—preferably about the [illegible] to a vibrating link B, constrained at [illegible] horizontally by the radius-rod C. From a [illegible] horizontal motion is communicated [illegible] from the outer end of which lever at [illegible] to the valve spindle by the link G. The [illegible] lever E partakes also of the horizontal [illegible] connecting-rod, to an extent equal to the amount [illegible] A; the centre H is for this purpose [illegible] is curved to a radius equal to the length [illegible] the lever E to the valve spindle. The [illegible] disc or sheave K, which is concentric with [illegible] at the moment when that lever is in the [illegible] being at either end of the cylinder. The [illegible] rotated on its centre, so as to incline [illegible] of the vertical, by means of the worm and [illegible] causing the curved path traversed by the [illegible] to cross the vertical centre line and diverge [illegible] will. The forward or backward motion of [illegible] by giving the slot this inclined position on [illegible] vertical centre line; and the amount of expansion depends on the amount of the inclination, the exactly central or vertical position being "mid gear." In that position steam is admitted at each end of the stroke to the amount only of the lead, and this is done exactly equally on each side of the centre line, the amount of lead being constant for forward and backward motion, and for all degrees of expansion. Thus when the crank is set at the end of the stroke either way, the centre H of the valve-lever coincides with the centre of the slot, and, therefore, the slot may be moved over from forward to backward gear without affecting the valve at all.

It will be seen at a glance that, if the inner end D of the lever E were attached directly to the point A on the connecting-rod, there would be imparted to the centre H of that level an unequal vibration above and below the centre of the disc. The extent of inequality would be twice the versed sine of the arc described by the inner end D of the lever E; and this would give an unequal port and unequal cut-off for the two ends of the stroke. But this error is corrected by attaching the inner end D of the lever E to the vibrating link B: for while the point A on the connecting-rod is performing a nearly true ellipse, the point D in the vibrating link B is moving in a figure like an ellipse bulged out at one side, and this irregularity is so set as to be equal in amount to the versed sine of the arc described by the inner end of the lever E, thus correcting the above error, and giving an equal travel to the centre H of the lever above and below the centre of the slot. At the same time the error introduced by the movement of the end of the valve-link G is corrected by curving the slot J to a radius equal to the length of G. These two errors may, however, be set against each other, and a compromise may be made by attaching the end of the lever E direct to the connecting-rod at A, and allowing the centre H to slide in a straight slot. By a just balancing against each other of the errors so produced, and by making the centre H of the lever E, and the centre of the disc, to coincide at varying points in the travel of the former, a fair motion may be got for the forward gear of an overhead marine engine, giving a longer cut-off for the up stroke than for the down stroke. This is of course at the sacrifice of the backward gear, in which the reverse is the case; and the various degrees of expansion are between the two extreme conditions.

Referring again to the equalizing of the traverse of the centre H of the lever E in the slot J, the unequal traverse may be either under-corrected or over-corrected by shifting the point D in the vibrating link B nearer or further from A; by this means a later point of cut-off may be given to either end of the cylinder at will, and the engine may thus have more steam admitted to one side of piston than to the other if required. The same thing may be done for the lead. By altering the position of the crank for which the centre H coincides with the centre of the slot J, an increased or a diminished lead may be given. The central positions and exact corrections are, however, in all cases standard and equal.

Hitherto the centre H of the lever E, which gives motion to the valve spindle, has been described as carried in a curved slot. This plan is given as the most simple to manufacture, and for clearness' sake has been adhered to throughout the description. But if preferred the centre H may be carried by a radius-rod for a marine engine. Here the centre H is supported by a link, and the other end of this link is carried by a weigh-lever whose centre takes the place of the centre of the slot J in the other design. In the central position of this weigh-lever the vibration of the link will make the centre H of the lever E describe identically the same arc as if moving in the slot J while in its central position; and by rotating the weigh-lever to either side of the centre line, the arc described by the link will correspond precisely with the curve of the slot in either of its extreme positions, as well as in every intermediate position to which the reversing lever may be set.

The peculiarities of this motion having now been described, it will be evident that it may be applied wherever the link gear is now employed: with this difference of general arrangement, that, where the link gear requires the centre line of the valve to be in the plane which contains the centre lines of the cylinder and crank-shaft, this gear requires the valve centre-line to be set in the plane which contains the cylinder centre-line, but is at right angles to the crank-shaft centre-line; that is, in a horizontal engine the valve must be on the top of the cylinder, and in a vertical engine it must be at the front of the cylinder, instead of at the side.

We now come to the advantages claimed for this system. Taking the link gear for our standard, for the reason already mentioned, these may be stated as follows. First, it is simpler and less costly than link gear by fully 25 per cent., taking the best forms of application in both. The writer has placed this advantage first, not because he thinks it by any means the most important, nor because any engineer would assign to it that place; but because, as is so well known, the first question asked by a proposing purchaser regarding any new invention which may be offered to him, always is—"Will it cost more than the old system?" To prove this, the various parts of a very well designed link motion have been compared with an equally carefully designed set of the new gear. In each case large and equally balanced wearing surfaces are provided for, no overhung bearings are allowed, and the best facilities for taking up wear and for overhauling are provided; and while the total weights for the link gear are 5 tons 6 cwts. 0 qr. 25 lbs., those for the new gear are 4 tons 0 cwt. 1 qr. 27 lbs., showing a saving in weight in favour of the new gear of 1 ton 5 cwts. 2 qrs. 26 lbs., or about 25 per cent. The saving is not only in weight, however, but also in the greater simplicity of parts, allowing increased facility for tooling and fitting.

Secondly, by placing the valve in the positions shown, namely in front in a marine engine, and on the top in a horizontal engine, a more simple and easily constructed form of engine is obtained. The cylinders also lie closer together, so that the engine is shortened in the line of the crank-shaft. Thus in a marine engine space is gained in the engine-room, while in a locomotive larger cylinders may be got into the confined space between the frames; and, the cranks being closer together, room is left for increasing the length of the main bearings of the crank-shaft. All the centre lines of construction are also either parallel or at right angles to one another. Thus all the parts of an engine come direct off the tool, and go square together, without any inclined faces, such as require care in setting and are more costly in erection.

Thirdly the new gear is more correct. In point of fact it is almost mathematically correct. By setting out the centre lines properly, where the lead and cut-off are exactly equal for both ends of the cylinder, and remain so in all grades of expansion to mid-gear; and where the port opens and closes by the amount given as lead at equal distances on each side of the centre line. The only variation is that the port for the rising stroke, in an overhead marine engine, opens a little wider than the port for the falling stroke. In practice, however, for setting the valves of such an engine, it is only neccessary to lift the valve on the valve spindle by the adjusting nuts so as to allow say ⅛ in. lead for the top and ⅜ in. for the bottom. Then the points of cut-off will follow relatively in similar proportion, where the leads and points of cut-off for a 48-in stroke are respectively ⅜ in. lead and 37 in. cut-off for the rising stroke and ⅛ in. lead and 35 in. cut-off for the descending stroke. These, compared with parallel diagrams, taken from a link gear, show the errors of the link corrected; the lead and cut-off with the link being ⅜ in. and 35 in. for the rising stroke, and ⅛ in. and 37 in. for the descending stroke. From this latter distribution of steam, as given by the link gear, there is a greater pressure of steam to drive the piston down when it is assisted by the falling weights, and a less pressure for the up stroke in which all the weights are to be lifted. This produces the result shown in the table below, as compared with the result given by the new gear.

TABLE OF TOTAL PRESSURES.

	DOWN STROKE.	UP STROKE.
Joy's Gear	Tons.	Tons.
	Mean Pressure = 98	Mean Pressure = 102
	(cut off at 35 in.)	(cut off at 37 in.)
	+ weights falling = 2	− weights lifted = 2
	Total...... 100	Total...... 100
Link Gear ...	Tons.	Tons.
	Mean Pressure = 102	Mean Pressure = 98
	(cut off at 37 in.)	(cut off at 35 in.)
	+ weights falling = 2	− weights lifted = 2
	Total...... 104	Total...... 96

It will be seen that with the new gear the total effective pressure is the same in both the up and the down stroke; while with the link there is an inequality (in the case of the particular figures given) of about 8 per cent.; an inequality very noticeable when an engine is running slowly, and though hardly to be detected, still existing even when the engine is at full speed. The equalizing and relieving of the strains by the new gear necessarily result in a more smooth and equal working, and less wear and tear, than can be obtained with the link arrangement.

Further an examination of the valve-path diagrams given by the new gear, and a comparison of them with others of similar constituents given by the link, will disclose another fact; namely, that the movement of the valve by this gear departs more widely from a continuously even speed than with the link motion; the acceleration is relatively augmented and the retardation prolonged, so that the valve receives a movement more resembling that produced by cams or tappets, but entirely free from the jerks or shocks inseparable from those motions, since the movement is here continuous. While the crank is passing its top centre, through the interval marked A to B, the motion imparted to the valve is caused by the centre H of the lever E (Fig. 1) sliding down the incline in the slot J, while the lever action of E is almost suspended. During this time the valve is being opened sharply by the inclination of the slot, and the result is a very rounded curve in the valve-path diagram. During the next interval B to C in the down stroke, the centre H of the lever is continuing to slide down the incline; but the lever itself has begun to take action as a lever, and this action is counter to, and partially neutralizes, the movement of the centre H. The result is a longer dwell of the valve, at the time when it is fully opened. During the next interval, while the crank passes from C to D, the movement of the centre H is almost *nil*, while the lever action of E is fully developed, and its motion is at its quickest. During this time the valve is being closed, and hence comes the prompter cut-off. In the next interval D to E, the lever action of E continues, though its effect gradually decreases, while its centre H is now sliding up the inclined slot J; thus both are acting in the same direction, but, as one diminishes while the other increases, the result is to maintain the speed of the valve nearly constant, until approaching the point E, when a considerable acceleration takes place by the centre H sliding more rapidly up the inclined slot. This occurs just at the point required for the release, which is thus effected by a quick opening of the exhaust port, giving the round full curve shown in the diagram at E. Then for the upward stroke the same action is repeated which we have just described for the downward one.

While the above advantages are gained for the full admission of steam still greater arise as we approach the higher grades of expansion. From the constant and unaltered lead at all points of cut-off, coupled with the peculiar acceleration and retardation given to the valve, as described above, a sufficiently satisfactory valve-path diagram can be obtained with a cut-off at one-third of the stroke, thus obviating the necessity for the employment of the usual additional expansion valve and gear.

A number of less important but yet valuable points remain to be named, but these need not be enlarged upon.

The new gear is more accessible than the old, as all the main working parts are brought down, and out to the front, and are placed close together under the direct inspection of the engineer, and within easy reach for examination and oiling. They do not, as with eccentrics, encumber the shaft and main bearings, which are here left quite open, and without moving parts about them other than the crank, thus rendering examination of and attention to these important parts more easy. Again, the complete gear is always in useful action, and for backward running the very same parts are employed as for forward running, and no others: the difference of direction being simply due to the altered positions of the parts. Hence no duplicate parts are carried, such as are required in the link gear, in which a complete set of eccentrics, straps, rods, &c., have to be provided for backward running. The whole of these are continually in motion, notwithstanding that in forward running their motion is not only useless, but is even prejudicial to the action of the forward gear. In Atlantic steamers, for instance, this useless working is continued for about ten days together, solely in order that the backward section of the gear may serve for a few back turns on arriving in port.

Overhauling for repairs and for taking up of wear will also be more easily executed with the new gear as the parts are removable more independently of each other; and one great source of wear, namely the eccentrics, is done away with.

This gear is also more easy to reverse, requiring less power than the link-gear; and the effect on the engine can be carried much further, as it is only necessary slightly to increase the angle of the slot J, in order to increase the opening of the port, and prolong the action of the steam on the piston, so far that, in whatever position an engine might be standing, it would start. Hence in a marine engine it would never be necessary to reverse in order to get off the bottom centre; and in a locomotive there would be no need for backing, such as is often resorted to when an engine is unable to start, owing to the considerable lap given to her valves, for the sake of employing high degrees of expansion. In either case it would only be necessary to move the reversing lever forward beyond the usual full steam notch (for which a provision is made), in order to permit the steam to follow the piston, if required, for even 9-10ths of the stroke; the engine would then have power to start, whatever the position of the cranks, or whatever the weight of the load.

A DEFENCE OF WELL-DECKED STEAMERS.

SUGGESTED BOARD TO FIX LOAD-LINES.

THE President of the Board of Trade when on his tour of inspection of the lighthouses and beacons of the north-east coast visited the extensive new docks and iron ship-building yards at the port of the Hartlepools. Richardson's marine engines, with the recently patented reversing gear, were exhibited, and Mr. Edward Withy, of the well-known firm of Withy & Co., iron ship-builders, conducted the right hon. J. Chamberlain and party, among whom were Sir R. Collinson, the deputy Master, Trinity House, Captain Webb, R N., and a number of marine and civil engineers, through the model rooms of the works. A large model of an improved well-decked steamer was exhibited, and Mr. Withy entered into a full and detailed description of the principles of the construction of this class of vessels. The remarks made by this shipbuilder are at the present time of intrinsic value. Well-decked vessels are now very extensively built, particularly at the north-eastern sea-ports, and much having been spoken against them by people who have had but little experience of their behaviour at sea, the observations contained in this article in their defence cannot fail to convince persons interested of the value of certain features of their construction. In the first place there are a few—though happily very few persons—who say that because they have no one deck that continues from stem to stern in the same plane, they are therefore weak vessels. In contradiction of this charge it is only necessary to remark (1) that all classification registries regularly assign to them their highest characters and (2) that no instance of one of them having parted at sea is, to my knowledge, on record. The principal causes of losses in open sea are, first, capsizing and, second, leakage. The first is occasioned by bad stowage or insufficient stability, and the second by the vulnerable openings in the deck being too low in the coamings, too weak or too near the surface of the sea.

The latter defect is peculiarly dangerous to the most vital openings, viz., those to the engine and boiler rooms, because they must always be open for partial ventilation, and feeding the fires. The statement constantly made is that the "well" would be better filled up, or rather, decked over. This will be admitted by every one, if the vessel be not at once more deeply immersed in the water. This deeper immersion is universally practised with what are known as "flushed-decked" vessels. In the latter class the main deck is put fully two feet under water, while in the former it is kept fully two feet out of it. The filling up of the well is good, so long as the extra buoyancy gained is not immediately neutralized by too much extra immersion. The advantages claimed for "well-decked" vessels, as compared with "flush double-decked ones, are," (1), they are less liable to shift their cargoes, because they have only *one* deck, under which the cargo should be trimmed close up; (2), the high-bridge sides give them great stability when "listed over," and they are therefore less liable to founder; (3), the boiler and engine hatch coamings are upon the bridge deck, which stands at least nine feet out of water, the bunker hatches are similarly elevated upon this bridge, and there being no close bulwark at all at its sides which can retain seas that may fall upon it, they are all much less liable to take in water than those on the upper deck of a flush-decked vessel. It is also evident that the iron bulkhead, which forms the front of the bridge-house, and which stands seven feet above the main deck, presents an effectual barrier to the seas which come over forward, and prevents their reaching the vital air openings. The "well" thus acts as a trap for the seas. The fourth advantage claimed is that the dangers which would otherwise undoubtedly attach to the well are minimised by the following features:—(*a*) the great rise of sheer forward; (*b*) that the deck is usually of iron; (*c*) the bridge front is of iron, and seldom has openings; (*d*) the great size of the hatchways, the height of their coamings, and the strength of the covers; (*e*) the large water ports to discharge the seas through; (*f*) another advantage is that the elevated platform amidships formed by the bridge-house is of great value to these vessels, affording great protection in bad weather to the undermentioned important necessities of safe navigation, viz., pilot-bridge, chart-house, galley, boats, midship steering gear, standard and steering compasses, the telegraph for communicating with the engine room, and the previously mentioned openings to the stoke-hole engine room and coal bunkers. Seeing that a well may be defined as "deck space, enclosed by a bulwark," it will be seen that this class of steamers does not possess a monopoly of the feature. Flush-decked vessels are mostly surrounded by a close bulwark, and so have a well all fore and aft, whereas in other vessels it is concentrated. If an objector to well-decked ships is taken to a flush-decked steamer which has no bridge or top gallant forecastle, especially if she be landed and ready for sea, and his opinion asked whether a long bridge would not improve her by sheltering the vital openings and whether a top-gallant forecastle would not reduce the quantity of water taken on board in a head sea, and so protect the hatches and do away with the sailors' companion—it is ten chances to one that he will assent. These are the views taken by the majority of the shipowners and captains owning and navigating this class of vessels, and the experience of our principal local insurance society is that their chief losses are very much less than with other types. Mr. Withy in explaining the models to the right hon. President of the Board, said he would take the liberty of strongly urging upon him that, should the Board of Trade contemplate legislation in the direction of fixing a load line, they should make ample inquiry from builders, owners, captains and underwriters as to their experience of the well-decked steamers, and especially that the statistics of missing and foundered vessels, separated into the various types of build should be procured from the underwriters. These are, without doubt, very wise suggestions, and drew from Mr. Chamberlain a pithy speech, in which he announced that it was his intention to bring a Bill before Parliament having reference to the fixing of the load-line. He was fully alive, he observed, to the fact that the question of fixing the load-line was very complicated, and there is no doubt that it is in the interests of all that the question should be settled, and that speedily. The existing law does not permit the Board of Trade to fix an absolute load line. There are, however, instances in which applications have been made to them to do so, but they have always declined to accede to the requests, and yet if the Board consider that a vessel is over-loaded they can detain it. This is, without doubt, an anomaly. The Board of Trade cannot properly take upon itself to fix a load-line, nor yet will it suggest where it should be fixed, but if the position does not meet its approval the vessel is stopped. If the Board did fix a load-line it would be compatible with perfect safety. But that would not be necessarily a commercial load-line, and such a load-line whilst designed in the interests of personal safety might seriously interfere with the interests of the shipping trade at large. On the other hand, we could hardly expect a tribunal to whom such questions might be referred in the first instance to give complete satisfaction. Because a load-line might be fixed at Hull which would not answer for Hartlepool and Liverpool, and in that way trade might be crippled. Mr. Chamberlain considered that it would be possible to establish a tribunal which would command the respect and confidence of both the general public and the shipowners as a class. It would be a tribunal for occasional resort, having judicial authority to settle all these questions as they arose. In a case like that, the shipbuilder should fix his own load line, and if the Board of Trade approved it there would be an end of it. If they considered there was not sufficient free-board, and if the builder and owner declined to accept the views of the Board, then the dispute should be settled by the judicial authority he proposed. If on this authority there shall be a large admixture of representatives of ship-builders, owners, Lloyds, and the Board of Trade itself, then there could be no ground for complaint. This is indisputably a capital suggestion and just what has long been wanted. By the means of such an authority the shipowning interest would be duly considered, and at the same time due guarantees taken for the security of life and property, in agreement with public opinion which demands protection both for the ships and the crews which sail in them. P.

LONG'S UNSINKABLE SHIP.

IT would be a great blessing to humanity in general, and to the commercial world at large if vessels could be rendered unsinkable, even when the hull were pierced or when water-logged. One of the characteristics of the present fine commercial and passenger steamers is their apparent liability to sink in an incredibly short space of time from damages created by a collision, by leakage, or by the breach of heavy seas over them. If life-boats have been so long a success as the best means of living through the roughest sea, why should not the principle be applied to all classes of vessels with equal success.

As a very successful experimental application of the unsinkable principle to vessels in general we illustrate that invented by Mr. Long, and lately put to a practical test off Woolwich. A launch built of steel, 36 ft. in length, 6 ft. in depth, and 5 ft. 8 in. in beam internally, is fitted with seven hollow metallic cylinders on each side, 3 ft. 6 in. in diameter, and 1 ft. 8 in. deep. These drums project on each side, but are so built into the frame of the hull, that they serve materially to strengthen the hull, and are not mere attachments, but form a cellular structure to the hull. These air-tight compartments can also be built and attached to the sides of any existing vessel. The deck extends over the tops of the drums, giving a width of 9 ft. over all. These drums are partly immersed on their under sides when the vessel is loaded, so that the amount of displacement increases so rapidly for increased depth that the draught remains very light even for a heavy freight. The launch illustrated was tried under steam, and a very good speed was attained, showing that the cylinder attachments are at least no hindrance when under steam, and as they allow a much greater press of canvas than could under ordinary circumstances be carried, they should thus add greatly to the speed obtainable from sailing vessels.

That the vessel so fitted is unsinkable is obvious to the most ordinary observer. Even if one or more of the cylinders were punctured there would still remain sufficient buoyancy to prevent foundering. This fact was exemplified by the inventor by means of an iron model, which refused to sink, although thrown into the water and thrust beneath the surface until completely filled with water.

The addition of these buoyant drums would have a marked effect upon cargo vessels as regulated by the Shipping Act for height of free-board. In the case of a heavy metal freight a much larger quantity could be stowed in Long's vessel than could be carried in an ordinary vessel within the limits of free-board allowed by the Act. The tonnage of the vessel would remain the same, as it would be by inside measurement, and a considerable economy to ship-owners should be thereby effected.

It is said to be the patentee's intention to give the greatest possible proof of his thorough belief in his invention, by crossing the Atlantic next year in his yacht. We must wish both him and his invention every success, as we must confess that when occasion requires our crossing the Atlantic or entrusting ourselves in any direction on the briny deep, it would much encourage our drooping spirits to know that the vessel was "unsinkable."

STAVER'S PATENT FISH FIN RUDDER.

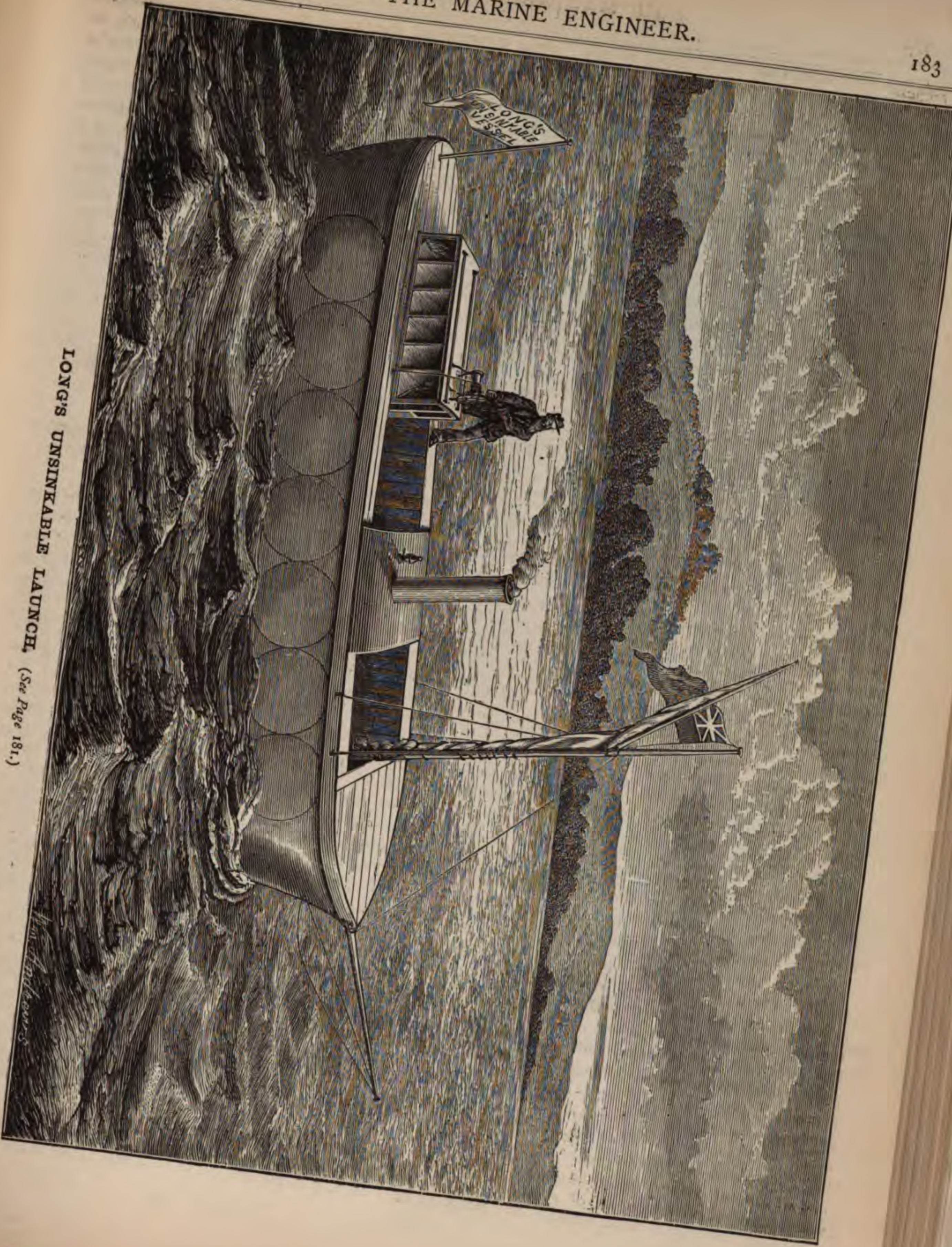
THE value of prompt steering qualities is daily becoming of greater consideration to ship-owners. The increasing length of the large mercantile steamers also necessitates more powerful means for steering than that given by the ordinary rudder and hand gear. Although steam and hydraulic steering gear is now being largely adopted, we do not think that this class of gear will alone attain the prompt steering required unless combined with exceptional rudder power or some such apparatus as that illustrated herewith. This invention (Staver's Patent) consists of fin rudders applied to the quarters of a vessel to aid the main rudder of a ship or steamer, whereby the steering of the vessel by the additional grasp of the water is greatly increased. Not only do these fin rudders add greatly to the steering power of a vessel, but they are also a very valuable security against loss of steering power by the destruction of the main rudder. The fin rudders are placed below the water line and as close aft as possible in such a position as to act independently of and without affecting the action of the main rudder. From their position they are protected much more than the main rudder from damage by heavy seas or by running aground, as the lower gudgeons stand some feet above the line of the keel. They may be fitted in recesses of the same depth as the thickness of the rudder, in such a manner as will not weaken the frame of the vessel, or they may be placed on the outside of the vessel with a plate running forward in a line with the main piece of the rudder in such a manner as will not impede the progress of the vessel, but will rather increase the strength of the quarter.

There is no fear of leakage as the rudder heads will come through the vessel's quarters in stuffing boxes, which can be easily kept water tight.

The fin rudders will be worked by the same gear as the main rudder when connected up. They may, however, be detached at will and worked independently of the main rudder from the lower deck, or from the iron flat in iron clads. In the former case the man on the lower deck is protected from heavy seas, and can be brought into use when the main rudder and tackle has been washed away. In the case of the iron clad the fin rudder would be below the water line and in the solid quarter of the ship, and thus not nearly so liable as the usual rudder to be shot away. The man also on the iron flat is under the water line, and thus amply protected. Another great advantage in their position is that they are front of the propeller and not behind it as is usually the case. They therefore steer in solid water instead of in the broken water from the propeller. This is of great importance for prompt and accurate steering when going slow and frequently stopping or reversing the engines as in working out of dock, a harbour or river.

In racing yachts, these additions ought to give greater advantage in sharper tacking or in rounding a turning point, and in such contests the smallest advantage.

The cost of fitting these additional rudders should be very small, as the gearing connected with them is simple, and even if never used except in an emergency they would seem to be an excellent investment as a precaution against the loss or break down of the ordinary rudder, well deserving the attention of all ship-owners.


LONG'S UNSINKABLE VESSEL

LONG'S UNSINKABLE LAUNCH. (*See Page 181.*)
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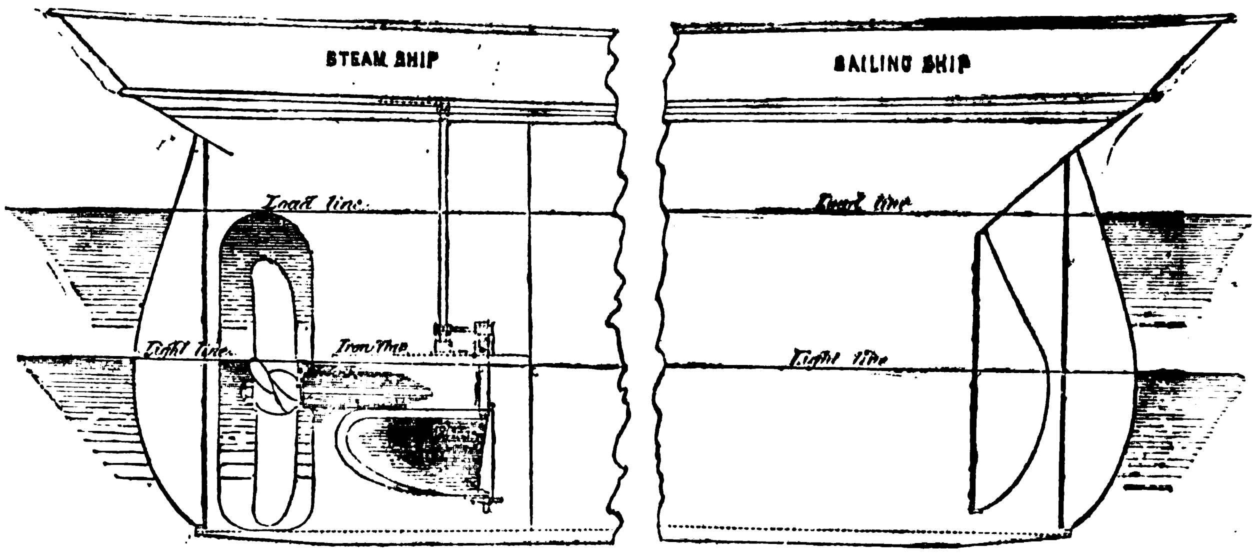


STAVER'S PATENT FISH FIN RUDDER (*See Page* 182).

LAURENCE'S CARGO BLOCK.

THE prompt handling of cargo in shipment and unshipment is well worth the best attention of shipowners, and nothing contributes more to the ease and rapidity of transhipment than the arrangement of the crane and lifting tackle. We illustrate this month an excellent cargo block (Captain Laurence's Patent), which has the following advantages over the ordinary hook.

First, absolute safety. This is provided for by the peculiar construction of the block. It will be seen by reference to the diagrams that the block is composed of two plates, bolted together by suitable rivetted pins. The fall chain passes round an arched piece projecting out of the line of the load, and embraces in a shackle both a swinging and a fixed hook. The fall chain is kept in position by the side cheeks of the plates, and by an extra stud, between which and the arched piece the fall chain passes, Fig. 1 shows the fall chain hauled tight, and the swinging link kept closed by the weight itself, so as securely to hold the load. In this way the load is its own safeguard against the weight being dropped accidentally, or before it is duly landed. To release the load when suspended the weight on the block must be taken from the fall chain by the releasing cord, and thus for cargo purposes the rope may be conveniently made of such slightness that it would more easily break than release the load whilst still suspended.

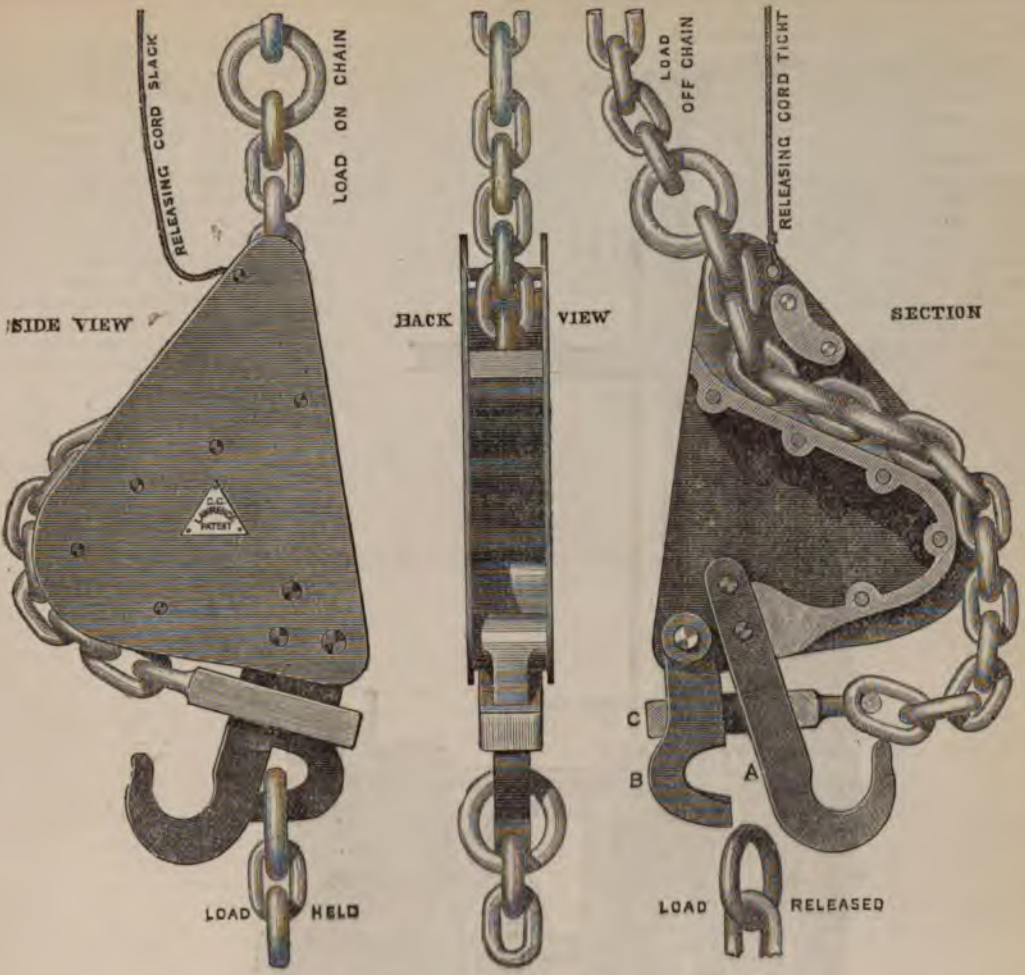
Secondly, it is labour saving, as the signalman to the crane, or the crane driver, can unhook in an instant after the load is landed. Fig. 2 shows the block with the weight on the fall chain released, and taken by the releasing cord. The shackle and swinging hook has immediately fallen so as to drop the sling chain.

Thirdly, the dispatch to be effected in the time of loading or unloading is great, as the unhooking does not require any laborious slackening and hauling out of the fall chain, as is usually the case, to get the hook free of the slings, but the moment the load is landed the sling can be released.

Fourthly, a very great advantage can be gained when the nature of the cargo allows of it, by placing the "standing" end of the sling on the hook, and the running end in the jaw. When the release is effected by pulling on the releasing cord, the sling is brought back on the hook. This latter arrangement is most advantageously employed in the case of goods which will not break, such as bar or pig iron or lead, coils of wire rope, rails, &c. Still more is this method advantageous in the case of cattle or horses. The moment the horse or bullock is landed, the sling may be released, and hauled away without any one approaching to release the sling, which is frequently a matter of some danger.

Fifthly, the weight of the block advantageously replaces the heavy iron balls now attached to ordinary fall chains for overhauling purposes.

For boat lowering purposes at sea, the Laurence Davits (not shown for want of space) take precedence, in our opinion, of all other inventions for the purpose. We form this opinion for several reasons. First, the boat can be safely carried "inboard," as is usual, but can be lowered out at such a distance from the side as to prevent the possibility of it being dashed against the ship's side in rough weather Laurence's Davits throw the boat to a distance of 16 ft. from the side, or can be lowered close to the side in



LAURENCE'S CARGO BLOCK.

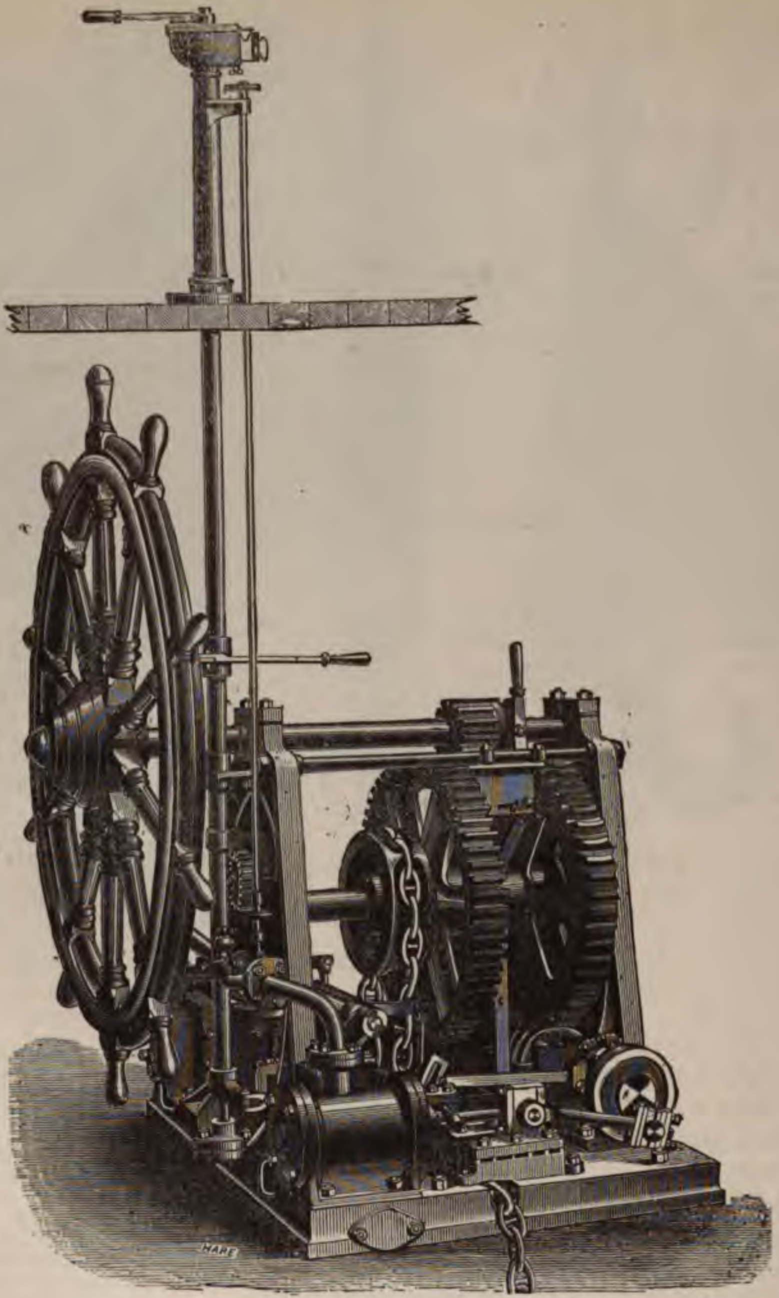
port when required. We have seen a report from the captain and officers of the P. & O. s.s. *Deccan*, as to the value of this arrangement at sea. Models of this apparatus may be seen at the inventor's address, 3, Fenchurch Buildings, E.C.

SIMEY'S STEAM STEERING GEAR.

STEAM steering gears are now being largely adopted in all large vessels of 2,000 tons and upwards. There is no reason that the application of steam gears should not extend to ships of much smaller tonnage. In fact, we understand that the river steamboats are already applying hydraulic steering gear throughout their steamers.

Amongst others, the s.s. *Triumph*, 3,000 tons register, built at Middlesborough by Messrs. R. Dixon and Co. for Messrs. Macintyre, of Newcastle-on-Tyne, has been fitted with Simey's steam gearing as illustrated herewith. This arrangement is one of the simplest that we have seen, and the parts are arranged very compactly. Two cylinders are bolted to the base plate, and their valve gear are connected by slot links which is operated by a weigh bar and reversing lever. The shaft driven by the two engines is fitted with a worm which gears into a worm-wheel on the main axle. The main axle is fitted with a drum and recesses, in which the main rudder chain works. The engine power is thus applied direct through the worm and worm-wheel to the rudder chains, so that the arrangement is comparatively noiseless, and there is no jar or rattle as there would be from cog-gearing.

The steam gear can be worked either by a short tiller or by a small hand-wheel from either an upper deck or from the bridge. The ordinary hand-wheel is



SIMEY'S STEAM STEERING GEAR.

fitted to a special counter-shaft which also is fitted with a sliding cog-wheel. This cog-pinion may be put, when desired, into gear with a large cog-wheel keyed on the main drum shaft. The hand-power gear can be thus thrown in when desired, should occasion arise. The engine has a valuable form of exhaust valve so arranged that any condensed water is got rid of through the exhaust the moment the engine starts.

HER MAJESTY'S SHIP "CROCODILE."

THE *Crocodile*, Captain Doughty, which, with the *Serapis*, has undergone a complete repair and refit by the Dockyard authorities at Portsmouth and been provided with new engines by Messrs, Humphrys, Tennant, & Co., of Deptford, made a six hours' trial of her machinery on Thursday, September 30th, between the Solent and St. Catherine's Point. The *Crocodile*, which was built by Messrs. Wigram, Blackwall, forms one of the noble fleet of Indian troop ships which were designed by the Constructive Department of the Admiralty during the controllership of Admiral Sir R. Spencer Robinson, the other vessels being the *Euphrates*, built and engined by Messrs. Laird; the *Jumna*, built by Messrs. Palmer & Co., and engined by Messrs. Maudslay & Son; the *Malabar*, built and engined by Messrs. Napier & Son; and the *Serapis*, which was built by the Thames Shipping Company, Blackwall, and engined by Messrs. Humphrys & Tennant. The ships are all so much alike in size and proportions that it is impossible to tell one from the other, except by the distinguishing band of colour on their sides. They are each 360 ft. in length, 49 ft. in breadth, and have a displacement of 6,211 tons. They are exclusively engaged in the transport of troops between Portsmouth and Bombay, making on an average two trips during the season through the Suez Canal, and can accommodate about 1,800 men with baggage, besides the officers and crew of the ship. Their average speed has hitherto been from eight to nine knots, but as their machinery has now been compounded with a view to the economical consumption of fuel, it is proposed to accelerate their speed to ten knots.

With their sister ships, the *Crocodile* and *Serapis* were originally fitted with horizontal simple engines, the boilers working up to a *maximum* pressure of 30 lb. to the square inch. The compound principle had not at that time been adopted into the service, but about five years ago the engineer department of the Admiralty had so far prepared for the change that in providing the two ships with new boilers they took the precaution to fit them with boilers capable of working at the increased pressure of 60 lb. There are eight of them, and they are heated by 24 furnaces 3 ft. wide, and of which the bars of 16 are 6 ft. 6 in. in length, and the rest 7 ft. 6 in. in length. The total area of fire-grate amount to 292 square feet. The new vertical compound engines which have been fitted by Messrs. Humphrys have one high-pressure cylinder of 66 in. diameter, exhausting into two low-pressure cylinders of 90 in. diameter, the stroke being 4 ft. 6 in. The high-pressure cylinder is carried by an A frame on the port side, and by polished wrought-iron columns on the starboard side. The low-pressure cylinders are carried by the surface condensers which consequently form the engine framing, on the port side, and by wrought-iron columns on the starboard side—an arrangement which secures great compactness, and enables all parts of the engines to be easily examined and overhauled. The condensers contain 16,500 ft. of cooling surface composed of solid drawn brass tubes five-eighths of an inch outside diameter, and 7 ft. 11 in. in length, the tubes being annealed and tinned inside and out. The condensing water (which is driven outside the tubes) is supplied by means of two large centrifugal pumps worked by separate engines. These pumps are also arranged to draw from the bilge, and as they are capable of discharging 600 tons of water per hour, they form a valuable safeguard in the event of water getting into the vessel at any time. The air, feed, and bilge pumps are not, as is customarily the case, worked by a rocking lever, but are placed beneath the cylinder and worked directly off the low-pressure pistons. Everything in connection with them, including the air-pump cases, is made of gun-metal. Auxiliary engines are provided for working the slides in addition to the ordinary hand gear, while auxiliary starting valves are fitted to the cylinders in order to facilitate the handling of the engines. The piston rods, which work upon shoe guides, are carried through the top cylinder covers to steady the pistons, and so prevent any possibility of wear to the cylinders. The low-pressure cranks are set at angles of 90 deg. and 135 deg. with the high-pressure crank. The general design of the engines is very simple, and all parts are easily accessible. They are very similar to the engines supplied by the same firm to the *Alexandra*, the flagship in the Mediterranean, the *Teméraire*, and the double-turret ship *Dreadnought*, which is now ready for commission at Portsmouth, the only difference being that the ironclads possess twin-screw engines indicating over 8,600 horse-power.

The *Crocodile* left the harbour on Wednesday and had a six hours' preliminary run, during which, with a view of shortening the duration of the official trial on the following day, the engines were worked for an hour with the jet injection in operation and with the expansion valve in full gear. The results gave an average of 46 revolutions a minute, a mean pressure in the high-pressure cylinder of 21·35 lb. and in the low-pressure cylinders of 4·36 lb., a total indicated power of 1,609·30 horses, and a speed of 10·877 knots. The vacuum in the forward and after condensers was 26·75 and 27·25 inches respectively. The six hours' full power trial on Thursday was conducted by Mr. Robert Humphrys, on the part of the contractors' firm and watched on the part of the Admiralty and Dockyard by Mr. Charles Icely, of the Steam Reserve; Mr. Bakewell, of the Controller's Department; Mr. W. Giles, chief engineer; and Mr. A. Durston, of the Factory Department. Captain Codrington took command of the ship during the trial, on the part of the Steam Reserve. It was intended that the *Crocodile* should have got under way at half-past eight, but at that time Spithead was concealed in so dense a fog that it would have been both useless and dangerous to begin the trial with the probability of having to ease the engines at any moment. An hour later, however, as the fog began to lift and afforded a prospect of a fine day, the ship got under way, there not being a particle of wind at the time, while the sea was as smooth as a duck-pond. The draught of the ship was 17 ft. 8 in. forward and 21 ft. 9 in. aft. It was not until 40 minutes past 10 that the half-hourly observations commenced. The boilers had been thoroughly repaired and strengthened, and the old brass tubes had been extracted and superseded by tubes made of iron. At the beginning of the trial the action of the boilers was somewhat irregular, and considerable judgment was required to prevent their priming, care being taken to gradually work up the engines to full power. The following are the tabulated results of each half-hour of the official steaming :—

Half-hours.	Boiler Pressure.	Revolutions.	Vacuum		Mean Pressure		Indicated Horse-power.
			For.	Aft.	H.P.	L.P.	
1	60	61·90	28¼	28	30·6	10·00	3,915·28
2	59½	62·03	28¼	28	23·9	9·00	3,899·26
3	58½	62·43	28	27¾	34·3	8·85	3,915·20
4	60	62·23	28¼	28	32·9	9·30	3,918·54
5	61	62·36	28¼	28	36·5	9·10	4,092·91
6	61	62·50	28¼	28	36·3	9·15	4,101·22
7	61	62·53	28¼	28½	36·0	9·10	4,074·89
8	61	62·13	28¼	28¼	34·1	8·90	3,895·57
9	61	62·53	28	28	32·7	10·35	4,153·59
10	59	62·76	27¾	27½	33·0	11·60	4,458·90
11	55	63·16	28	28	27.9	11·35	4,131·63
12	58	62·83	27¾	27½	29·2	12·25	4,382·52
Mean	59·51	62·45	28·10	27·95	33·1	9·91	4,078·29

The other means obtained were :—Power indicated by high-pressure cylinder, 1,929·31, and by low-pressure cylinders 2,148·98 horses; the mean speed of the ship (as determined by a couple of incidental runs upon the measured mile) being not less than 14·21 knots per hour. The engines worked with remarkable regularity and smoothness from first to last, and no trouble was experienced with respect to the bearings. As will be seen from the figures, the uniformity and height of the vacuum were exceptional. The screw used on the occasion was an ordinary Griffiths, which originally belonged to the *Serapis*, the action of which surprised the engineers present by its freedom from vibration, as compared with the propeller of the *Serapis*, which was tried a few days previously. It had four blades, having a diameter of 21 ft. 2 in., and a mean pitch of 23 ft. 6 in., its upper edge being immersed to the extent of 6 in. The pitch, which was as fine as it was possible to make it, was well adapted for the usual service requirements, but was evidently too coarse for high rates of speed and acted as an appreciable drag upon the machinery. As the performances of the engines gave ample satisfaction to the superintending officers at the end of the first four hours, it was determined to press the boilers for the remainder of the trial for experimental purposes. With this object the blast was turned on, an indicated power of 4,281 horses being the result, or considerably over the contract. And considering that the powe of the *Serapis* rose from 3,796·86 during the six hours' trial to 4,028 upon the measured mile, it is confidently anticipated that when the *Crocodile* makes her commissioned speed trial in Stokes Bay, her engines will develope as much as 4,400 horses, though as a matter of course, as her draught will be greater, she will make fewer knots. The coal consumption during trial was 334 cwt. during the first four and 522 cwt. during the whole six hours, giving 2·3 lb. per indicated horse-power per hour.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Falernian.—On the 24th September there was launched from the shipbuilding, engineering, and repairing works of Oswald, Mordaunt & Co., Southampton, an iron screw steamer of the following dimensions:—Length, register, 340 ft.; breadth 34·1 ft.; depth, 23.11 ft.; gross tonnage, about 2,250 tons. The vessel has been built to the order of Messrs. Fredk. Leyland & Co., of Liverpool. She is fitted with a short, full poop, containing wheel-house and store-rooms; amidships there is a long bridge deck, extending the full breadth of the vessel, enclosing the engine and boiler casings, donkey boiler, galley, and accommodation for the captain, officers, and engineers, also four state-rooms for eight passengers, with a saloon. Upon the bridge deck is fitted the wheel and chart house, also accommodation for all boats. A full forecastle is fitted forward, on which the anchors are worked, Baxter's patent windlass being fitted immediately below. The inside forecastle is fitted up for petty officers, seamen, and firemen, and contains all necessary store-rooms, &c. The vessel is brig-rigged, with iron pole masts, and is classed 20 years Red in Liverpool Underwriter's Registry. This is the second of four steamers now building for Messrs. Fredk. Leyland & Co., by the builders. On leaving the ways she was christened the *Falernian* by Miss Davidson.

Redbrook.—On the 2nd October there was launched from the yard of Palmer's Shipbuilding and Iron Company at Jarrow an iron screw steamer, named the *Redbrook*, belonging to Messrs. John Cory & Son, Cardiff. The dimensions of the steamer are:—Length, 735 ft.; breadth, 32 ft.; and depth of hold, 17 ft. The engines, also by Messrs. Palmer, are 120 h.p. nominal. The *Redbrook* is classed the highest class at Lloyd's, and is intended for the general trade. The ceremony of christening was performed by Miss Armstrong, daughter of Mr. Robert Armstrong, manager of the shipyard.

Ascanius.—On the 2nd October the steamship *Ascanius* was launched in the Birkenhead float by Messrs. Cochran & Co., the builders of the vessel, and who are also supplying the machinery, including one of their patent boilers. This steamer, which is built for the Ocean Steamship Company (Mr. Alfred Holt's line of China steamers), is intended for the coasting trade near Penang, and will start for her destination in a few weeks.

Seaham Harbour.—On the 4th October Messrs. Edwd. Withy & Co. launched from Middleton Shipyard, West Hartlepool, an iron screw steamer, built to the order of the Marquis of Londonderry. This vessel is No. 90 in the builder's yard, and is the third built by them for the same owner. Her principal dimensions are:—Length b.p., 275 ft.; beam, extreme, 38 ft.; depth, moulded, 19·6 ft. She has a long full poop and f.g. forecastle, double bottom all fore and aft, constructed on the longitudinal and bracket system, main deck of iron throughout, four very wide and long hatchways for facility in loading coals, and four steam winches. She will be topsail schooner-rigged, and all her deck fittings will be of teak, has iron-framed chart and wheelhouses, and iron main rail between poop and forecastle. The rudder is constructed with loose pintles of steel, Holliday's patent steam steering apparatus will be fitted amidships, and Hartie's screw gear aft. Engines of 170 nominal horse power will be supplied by Messrs. T. Richardson & Sons, of Hartlepool Ironworks. The vessel will carry 2,500 tons deadweight, and is specially arranged for rapid discharging, being intended for the Sunderland and Thames coal trade in the winter, and for the Atlantic, Mediterranean, or Eastern trades at other seasons. As the steamer left the ways she was christened *Seaham Harbour* by Mrs. Warham. The vessel will be under the management of Mr. S. J. Ditchfield, of Seaham Harbour.

Steam-Tug.—On October 5th Messrs. R. & H. Green launched from their shipbuilding-yard at Blackwall, London, a screw-tug for the Crown Agents for the Colonies, and intended for service at the Colombo Harbour Works. She has been constructed from the design and under the directions of Mr. J. A. Welch, the naval architect to the Crown Agents for the Colonies, and is fitted by Messrs. Alexander Wilson & Co. with compound surface-condensing engines. In a few days she will sail out to Colombo.

Almirante Brown.—There was launched on October 6th, from the shipbuilding yard of Messrs. Samuda Brothers, at Poplar, a steel armour-clad corvette, built for the Government of the Argentine Republic. Undeterred by the dull weather, a numerous company proceeded, for the purpose of witnessing the ceremony, down the river to Poplar on board the *Albert Victor* steamboat, which started from Westminster Pier, and arriving at the scene of the launch, the yard was found crowded with spectators, notwithstanding the rain that had then set in. The invited guests obtained, however, the shelter of a roofed platform erected midway up the bows of the new war-ship, and here Madame Martinez de Hoz gracefully performed the dual operation of christening and launching the corvette amid the cheers of the assemblage. Amongst those present were Mr. J. D'A. Samuda, Senor Manuel, R. Garcia (Minister of the Argentine Republic), Mr. Stewart Rendell, M.P., Mr. C. M. Norwood, M.P., Sir Arthur Blyth, K.C.M.G., Sir George Chambers, Mr. M. J. de Yaniz (Argentine Consul), Commander Urtubey, A.N., Lieutenant Garcia, A.N., Mr. David J. Ford (engineer A.N.), Mr. H. Davidson (chief of the Argentine torpedo division), Commander Munroz, Captain R. Dominguez, Colonel Jaia Almonte (Secretary of the Peruvian Legation), Colonel Martindale, Mr. and Mrs. Walter Maudslay, Mr. N. Barnaby, C.B. (Director of Naval Construction at the Admiralty), and other gentlemen from Admiralty departments. By the time-honoured process of smashing a bottle of wine, swung by a ribbon against the bow, Madame Martinez de Hoz named the corvette, *Almirante Brown*, the vessel being so-called after a distinguished Irishman, whose name is much revered throughout the provinces of the Rio de la Plata, for he fought gallantly in the war of Independence. Then, using a silver-mounted mallet and hammer of oak, the lady severed a rope passing around the bows, which act, by a mechanical contrivance, the dogshores having been knocked away, allowed the newly-named *Almirante Brown* to glide steadily into the water, the national flag of the Argentine Republic floating from her stem, while the band of the Royal Artillery, stationed in the yard, played the National Hymn of the far-away Republican community. This latest addition to the fleet of the Argentine Republic, which already possesses two ironclads, besides a number of gunboats, corvettes, and torpedo-boats, is a corvette 240 ft. long, 50 ft. broad, 30 ft. deep, and her displacement tonnage is 4,200 tons. The thickness of her steel-faced armour is 9 in. and 6 in., and she will carry eight guns 8 in. in bore, of about 11½ tons each, and six guns of a small callibre on the upper deck. The engines are of 4,500 indicated horse power. At a luncheon which subsequently took place in a gaily-decorated shed in the yard, Mr. J. D'A. Samuda, who presided, in proposing "Success to the *Almirante Brown*," gave some further interesting details as to the construction of the vessel, which he stated possessed many features of interest to marine constructors. First of all he dwelt upon the growth of the country forming the Argentine Republic, its fertile soil, and capability of producing food for this country. The *Almirante Brown*, he remarked, had the peculiarity of being built entirely of steel, and of having the armour with which she was surrounded made also steel-faced, being technically compound armour. This was the first man-of-war in which steel had entirely taken the place of iron, both in the hull and the armour, and he thought his Excellency Senor Garcia was to be complimented upon obtaining for his country the position of being the pioneer in having a vessel of this description. Consideration on the ground of novelty might also be claimed for the armament. There were six long breech-loading guns, each of over 11 tons weight, placed within the steel battery of the vesssel. These guns were the latest production of the Armstrong invention, and possessed a power of penetration equal to that obtained by the ordinary 25-ton muzzle-loading gun, and therefore all must look for the adoption in the English navy and elsewhere of guns of this kind in place of much heavier but less effective gun made on the muzzle-loading principle. The arrangement of the armament was such that there could be fired three guns directly ahead, supported materially by two others, and, when required, there could be an all-round fire, and three of these guns could always be brought to bear on the broadside fire of the vessel. Whether regard was paid to the force of penetration, or the arrangement of the battery, nothing of the same weight, size, and condition has been obtained previously which was superior. So as to enable the corvette to keep at sea for a long time without fouling her bottom, the whole of the outside of the vessel, after being built with iron, was covered with teak, and that again was sheathed with zinc. The engines were to be the production of Messrs. Maudslay & Field, and had rare advantages. There were two complete and distinct sets of engines, placed in two entirely separate engine rooms, and each set would work its own particular screw. Working full power, the vessel would be propelled through the water at a speed of 14 knots an hour, but if there were any accident to one set of engines the other set alone would enable the vessel to go at the rate of nearly 12 knots an hour. Pointing out that the corvette was covered with steel-faced armour, Mr. Samuda proceeded to say that from experiments made by the English Government it was proved that steel-faced armour of nine inches thickness had a resisting power to shot equal to the ordinary iron generally used of 12 in. diameter, and as the *Almirante Brown* was fitted with nine inches of steel armour over the important parts, there was provided in a comparatively small vessel an amount of resistance considerably in excess of that to be found existing in any frigate at present in the English Navy, and very nearly equal to twice the resisting power of most of the previously built iron frigates of double the tonnage and double the displacement. The *Almirante Brown* could steam nearly 4.000 miles with the coals she could carry in the bunkers. The toast was responded to by Senor Garcia, who proposed the sentiment of prosperity to the firms of Messrs. Samuda Brothers and Messrs. Maudslay & Field. Briefly replying, Mr. Maudslay said that the engines to be fitted in the *Almirante Brown* would represent, as nearly as possible, the engines fixed in H.M.S. *Conquerer*. Soon afterwards the company returned to town on board the *Albert Victor*.

Ybarra No. 3.—On the 6th October there was launched from the shipyard of Messrs. Raylton, Dixon & Co., of Middlesbrough, an iron screw steamer, built especially for the iron ore trade, and of the following dimensions:—250 ft. long; 33 ft. 6 in. beam; 17 ft. depth of hold. The vessel has a long poop extending over the engine and boiler space, water ballast throughout, topgallant forecastle for officers and crew, cabin and saloon aft under poop, schooner-rig, iron main deck. Her dead weight capacity will be about 1,800 tons. She will be fitted with engines of 140-horse power by Messrs. Blair & Co., of Stockton. She has been built for the well-known firm of Messrs. Ybarra, Hermanos & Co., of Bilbao, being the second steamer built by Messrs. R. Dixon & Co. for this firm, and on leaving the ways was christened *Ybarra No.* 3.

Delcomyn.—On the 6th October Messrs. Wigham Richardson & Co., of the Neptune Ship and Engine Works, on the Tyne, launched an iron screw steamer, built for the Eastern and general service. She is of the following dimensions:—287 ft. long, 36 ft. beam, 25ft. 6 in. depth of hold. This vessel will be fitted by the same firm with compound engines, having cylinders of 31 in. and 62 in. diameter, and 48 in. stroke, replete with all the latest improvements to economize fuel, &c. This vessel has a poop and topgallant forecastle, with suitable houses in midships for officers, engineers, chart-room, &c. Her deadweight capacity will be upwards of 2,700 tons with water ballast throughout. She has been built for Mr. William Lund, of London, and on leaving the ways was christened the *Delcomyn* by Mrs. Lund.

Pride of the West.—On the 7th October a schooner, named the *Pride of the West*, was launched from the building-yard of Captain Charles Rawle, Upper Docks, Padstow. She is about 220 tons burthen, and to class 14 years A 1 at Lloyd's.

Yesso.—On the 16th October Mr. Laing launched from his Deptford yard, on the Wear, a screw steamer, to the order of Messrs. G. D. Pinkney & Son, Sunderland, of the following dimensions, viz.:—Length, 305 ft.; breadth, 35 ft.; depth, 20 ft.; awning deck, 7 ft.; classed 100 A 1 at Lloyd's. The vessel has water ballast, iron maindeck, chart-house, wheel-house, &c. She will also be fitted with all modern improvements, including Higginson's steam steering gear, Emerson, Walker & Co.'s direct steam windlass, Colling & Pinkney's topsail reefing gear, &c. She will be supplied with compound engines 200-horse power by Mr. G. Clark, Southwick. As the vessel glided into the water, Mrs. W. Priestly, daughter of the senior partner, named the vessel the *Yesso*.

Teddington.—On the 16th October an iron screw steamer, of the following dimensions:—Length, 285 ft.; breadth, 36 ft.; depth of hold 24 ft. and built to the order of Messrs. W. Milburn & Co., of London and Newcastle, was launched by Messrs. C. S. Swan & Hunter, Wallsend-on-Tyne. This is to class 100 A 1 at Lloyd's under special survey, and was named the *Teddington*. She will receive engines and boilers of 235-horse power, by Messrs. Thos. Clarke & Co., Elswick.

Spark.—On October 18th, an iron screw steamer built to the order of John W. Smith, Esq., Hull, was launched from the shipbuilding-yard of Mr. Robert Thompson, jun., Southwick; her dimensions being about as follows, viz.:—240 ft. by 32 ft., and 17 ft. depth of hold, having been constructed under the special survey of Lloyd's to class 100 A 1. The vessel is built on the two-decked rule, with a full poop extending past amidships, with large galley, chart-house, and cabin fitted up in the usual style for Captain and Officers, and accommodation for engineers, also full topgallant forecastle for crew; is schooner-rigged, with iron lower masts, ample water ballast, three steam winches and donkey boiler by Messrs. Clark, Chapman & Gurney, of Gateshead; Harfield's patent windlass, patent steering gear worked from chart-house, &c. Her engines which are on the inverted direct acting compound surface condensing principle, and 115-horse power, have been built by Mr. George Clark, Southwick Engine Works. As the vessel left the ways she was named the *Spark* by Miss C. Smith, of Hampstead, London.

Furnessia.—On October 19th, the Barrow Shipbuilding Company launched from their yard the Anchor Line steamship *Furnessia*, which is the largest vessel, with the exception of the Great Eastern ever built in England. Her dimensions are:—Length between perpendiculars, 445 ft.; beam, 44 ft. 6 in.; depth of hold, 34 ft. 6 in.; her gross tonnage being 5,500 tons; and her displacement, when drawing 26 ft. of water, 9,900 tons; cables are 2$\frac{5}{16}$ in., and are worked by Emerson, Walker & Co's. Patent Horizontal Direct Steam Windlass. She will be brig-rigged, and have two funnels. Her engines are of the inverted direct-acting, surface-condensing type, of 600 nominal horse power, and 3,800 indicated horse power. The high-pressure cylinder measures 49 in., and the low-pressure cylinder 100 in., the length of stroke being 5 ft. 6 in. She will be fitted as a high-class ocean-going steamship, with accommodation for 200 cabin, 30 second class, and 300 steerage passengers. The *Furnessia* is owned by the Barrow Steamship Company, but is intended to form one of the Anchor Line fleet sailing from the Clyde to New York. Miss Dorothy Egerton, grand-daughter of the Duke of Devonshire, performed the ceremony of naming the vessel. The *Furnessia* will be ready for her station by about Christmas.

Julia.—On the 19th October, at West Hartlepool, Messrs. Irvine & Co., launched a new craft 60 ft. by 11 ft. by 5 ft. She is a steam launch classed A 1 at Lloyd's, being fitted with powerful compound engines by Alex. Wilson & Co., of London. She is built for Mr. E. D. le Pouteur, Lloyd's agent, St. Malo. She was christened the *Julia* by Miss May Irvine.

Gulf of Finland.—On the 19th October, Messrs. William Gray & Co. launched from their yard, at West Hartlepool, an iron screw steamer of the following dimensions:—Length, 296 ft.; breadth, 37 ft.; depth of hold, 23 ft. 6 in. and 30 ft. 6 in., is fitted with Emerson Walker's Patent-Combination Windlass, and built with long full poop and forecastle; her bottom is on the new longitudinal bracket system; hull and engines are classed 100 A 1 at Lloyd's. She is intended for the East Indian trade, and is the second launched from this yard this year for the Greenock Steamship Company. The steamer was named as she started from the ways the *Gulf of Finland*, by Miss M'Dougall, daughter of the manager of the company. The steamer has been taken to Stockton for her engines, made by Messrs. Blair & Co.

Renfrew.—On the 21st October, there was launched from Palmer's shipyard, Jarrow-on-Tyne, a screw steamer for the Caledonia Steam Shipping Company, which was formed six months ago in Liverpool. The vessel is 285 ft. long, 37 ft. beams, and 24½ ft. depth of hold, with a carrying capacity of above 3,000 tons. Mrs. Macnaughton, of Liverpool, wife of the manager, named the ship *Renfrew*. This is the second vessel Palmer's Company have built for the Caledonia Company.

Sapphire.—On the 20th October the *Sapphire*, an iron screw steamer, was launched from the building-yard of Messrs. Richardson, Duck, & Co., South Stockton. The dimensions of the vessel are as follow: Length over all, 286 ft.; ditto between perpendiculars, 277 ft.; extreme breadth, 36·6 ft.; depth in hold, 24·6 ft.; ditto moulded, 25·10 ft.; gross tonnage, N.M., 2,081 tons, her dead weight capacity being about 3,000 tons. She is classed 100 A 1 at Lloyd's as a three-deck ship, under special survey, being considerably stronger than required for classification. She has a double bottom, and tank hold capable of containing 550 tons water ballast. She has been specially designed for the Atlantic trade, and fitted with double stanchions for shifting boards in 'tween decks. Her engines (190-horse power) are supplied by Messrs. T. Richardson & Sons, Hartlepool, and are on the compound direct-acting principle, with cylinders 34 and 63 inches diameter, stroke 36 inches, and a working pressure of steam of 80 lbs. The *Sapphire* has been built to the order of Messrs. C. O. Young & Christie, of Cardiff.

Claudius.—On the 21st October Messrs. Joseph L. Thompson & Sons launched from their shipbuilding yard, North Sands, an iron screw steamer built to the order of Mr. Thomas Kish and partners, of Sunderland. The vessel is of the following dimensions, viz. :—Length, 260 ft.; breadth, 36 ft.; depth of hold, 18 ft. 6 in., with a dead-weight carrying capacity of 2,250 tons. The naming of the vessel *Claudius* was performed by Miss Kish, sister of the managing owner. The *Claudius* is intended for the Atlantic and Mediterranean trades.

LAUNCHES.—SCOTCH.

Janet M'Neil.—On the 5th October Messrs. Russell & Co., launched at Port Glasgow an iron sailing barque of the following dimensions:—Length, 194 ft.; breadth of beam, 32 ft. 6 in.; depth of hold, 19 ft. 7 in.; and 900 tons. She was named the *Janet M'Neil* by the wife of one of the owners. This barque has been built for Messrs. Brown & Watson, Glasgow, and when fitted out she will load in Glasgow for the East.

Express.—On the 5th inst. Messrs. D. & W. Henderson & Co., launched from their shipyard at Meadowside, Partick, a steam tender of the following dimensions:—Length, 150 ft.; breadth, 25 ft., for Messrs. Henderson Brothers, of the Anchor Line. The ceremony of naming the tender the *Express* was performed by Miss Meiklereid, daughter of the well-known Superintendent of the Line.

Marana.—On the 5th inst. Messrs. Aitken & Mansel launched from their Whiteinch yard, near Glasgow, a screw steamer of about 2,300 tons register, for Messrs. George Bell & Co., of Liverpool, for their Liverpool and South American trade. This vessel, which received the name *Marana* from Miss Bell, has been built under the supervision of Messrs. M'Kaig & Stott, engineers, Liverpool, and will be fitted with machinery of 250-h.p. by Messrs. John & James Thomson, Finnieston Foundry, Glasgow.

Castellano.—On the 6th October, Mr. Robert Chambers, jun., launched from his yard at Dumbarton, the screw steamer *Castellano*, a sister ship to the *Filipino*, launched a few weeks ago. These vessels are built to the order of Messrs. Olano, Larrinaga & Co., Liverpool, for coasting among the Phillipines. They are 400 tons burthen, schooner-rigged, with decks of teak, and will be fitted with awning decks amidships, and canvas awnings fore and aft. The engines, compound surface-condensing, of 360-horse power indicated, are by Messrs. M. Paul & Co. and the vessels are expected to attain considerable speed. The *Castellano* was named as she left the ways by Miss Jane E. Thompson, Hawick.

Kerbella.—On the 6th October, Messrs. Wm. Denny & Brothers launched from their shipyard at Dumbarton the *Kerbella*, an iron screw steamship, of the following builders' dimensions:—235 ft. by 35 ft. by 26 ft. 6 in., and about 2,000 tons gross measurement for the British India Steam Navigation Company (Limited). She has been built to class 100 A 1 at Lloyd's, under special survey, and is to be fitted with compound surface-condensing direct-acting inverted-cylinder engines of 200-horse power nominal, by Messrs. Denny & Co. She is constructed on the continuous double-bottom system, so largely employed by her builders, and with deep plate frames on the sides. The *Kerbella*, on leaving the ways, named by Miss Frizell, daughter of Charles Frizell Esq., Castle Cavan, county Wicklow.

Leon XIII.—On the 7th October there was launched from the shipbuilding yard of Messrs. John Elder & Company, Fairfield, Govan, an iron screw steamship for the Marquis de Campo, called *Leon XIII.* The vessel is intended for the conveyance of the Royal mail, together with passengers, troops, and merchandise from Spain to Manila, taking her departure from Liverpool. Her principal dimensions are:—Length between perpendiculars, 315 ft.; breadth, 36 ft.; depth (moulded), 25 ft. 9 in.; and the gross tonnage 2,200. She has been built to the highest class at Lloyd's, under special survey, and her engines will be of the newest and most approved type, on the compound principle, with high-pressure cylinder 38 in., and low pressure 68 in. diameter, by 4 ft. stroke. The engines will be fitted with Messrs. Brown Brothers' combined steam and hydraulic reversing donkey engines. Steam will be supplied by two double ended cylindrical tubular boilers working up to 75 lbs. pressure. The indicated horse power will be 1,600. The vessel will have accommodation for 50 first-class passengers. Special attention has been devoted to the lighting and ventilation, each cabin having a large square port through ship's side; and, in addition to the ordinary cowl ventilators, a powerful fan, driven by a special engine, is employed to exhaust the foul air from the cabins; the same fan being also used to ventilate the second-class cabins and the soldier's quarters. Berths are provided for 30 second-class passengers on the main deck, and the cabins in which these are placed are large and well ventilated. The remaining portion of the main deck is fitted up for the accommodation of soldiers. The officers and crew are berthed on the upper deck, the former in deck-houses and the latter in the topgallant forecastle. The vessel is rigged as a three-masted schooner, with lower masts of iron. She is also fitted with patent steam windlass, powerful steam winches, fresh water condenser, steam pumps to each hold, in addition to the usual hand pumps, steering gear both aft and amidships, together with all other appliances for working the vessel and loading and discharging cargo. As the vessel left the ways she was named the *Leon XIII.*, by Mrs. De Pedrorena, wife of the Spanish Consul.

Maipu.—On the 18th October there was launched from the shipbuilding-yard of Messrs. John Elder & Co., Fairfield, Govan, a steel paddle steamer for the Argentine Republic. The vessel is intended for torpedo warfare, but may also be used for surveying purposes. Her principal dimensions are:—Length between perpendiculars, 240 ft.; breadth, 30 ft.; depth, moulded, 14 ft. 3 in.; her tonnage, B.M., being 1,062 tons. She will be propelled by two diagonal oscillating engines, one working each paddle-wheel, and for manœuvring purposes these are made capable of being connected or disconnected at will. The high-pressure cylinder of each engine is 30 in. in diameter, and the low pressure is 56 in. by 5 ft. 6 in. stoke. Steam is supplied by four steel single-ended boilers, working up to 75 lbs. pressure, and capable of driving the vessel at a speed of 15 knots an hour easily. She has two pole masts, is of light schooner rig, and has a ram bow. The whole of the 'tween decks is fitted up for the accommodation of the officers and crew, the magazines, store-rooms, shell-rooms, &c., being below. She carries one 40-pounder Armstrong steel breech-loading gun forward, while aft she has one Hotchkiss 5-barrelled 4-pounder gun and two other mitrailleuses. In addition to these her armament will consist of spar and Whitehead torpedoes. As she left the ways she was named the *Maipu* by Miss Francis, of Glasgow.

Phasis.—On the 20th October Messrs. Barclay, Curle, & Co. launched from their yard at Whiteinch, an iron sailing ship of 1,560 tons register, built of the highest class at Lloyd's, for Messrs. A. & J. H. Carmichael & Co., Greenock. As the ship left the ways she was named the *Phasis* by Miss Deans, of Braehead House, Stewarton, Ayreshire.

Buckhurst.—On the 21st October, Messrs. Archibald M'Millan & Son launched from their dockyard, Dumbarton, the sailing ship *Buckhurst*, which they have built for Messrs. W. R. Price & Co., London. The dimensions of the *Buckhurst* are the following:—277 by 40½ by 24 ft., the register tonnage is about 1,950 tons gross, and she is one of the largest carrying ships ever built, having a deadweight capacity of 8,300 tons. The *Buckhurst* is being fitted with every improvement the experience of her builders and owners can suggest for safety, efficiency, and economy of working in all details. The vessel was named by Mrs. M'Millan, Rockville, Dumbarton.

Cambrian.—On the 22nd October, Messrs. John Fullerton & Co., launched from their yard at Merksworth, Paisley, an iron screw steamer of 500 tons, built to the order of Messrs. J. & J. M'Farlane, Glasgow. She is to be supplied with compound engines of 60-horse power nominal, by Messrs. William King & Co., Dock Engine Works, Glasgow. As the vessel left the ways she was named the *Cambrian* by Mrs. James M'Farlane, Glasgow.

Ballochbuie.—On the 22nd October there was launched from the building-yard of Messrs. Hall, Russell & Co., Footdee, an iron screw-steamer of the following dimensions:—Length, 195 ft.; breadth, 31 ft. 6 in.; depth, 13 ft. 6 in.; gross register, 790 tons. The vessel has been built under special survey to class 100 A1 at Lloyd's, and will be fitted with compound surface-condensing engines of 85-horse power nominal, water ballast, steam winches, and other improved appliances for facilitating the loading and discharging of cargoes. The steamer has been built to the order of Messrs. J. & A. Davidson, and is intended for the Baltic and Mediterranean trades. She will be under the command of Captain Macdonald, late of the *Benamain*. As she was leaving the ways she was named the *Ballochbuie* by Mrs. Jamieson, wife of the Lord Provost of the city. The *Ballochbuie* forms the eleventh vessel of Messrs. Davidson's "B" line of steamers.

Valencia.—On the 23rd October, Messrs. Henry Murray & Co. launched from their yard, at Kingston, an iron screw steamer, built for Messrs. Goodyear & Co., of Liverpool, and intended for the Mediterranean trade. The dimensions of the *Valencia* are 175 ft. in length between perpendiculars by 25 ft. 6 in. beam by 12 ft.

11 in. depth of hold. She registers 344 tons nett, and classes in Lloyd's highest grade. The vessel, which is to be commanded by Captain George Pearce, will be fitted by Messrs. James Howden & Co., Glasgow, with a pair of 80 nomnial horse-power compound engines.

LAUNCH.—Irish.

Parkmore.—On the 4th October, at Belfast, Messrs. MacIlwaine & Lewis launched a screw-steamer named the *Parkmore*, of the following dimensions :—Length over all, 160 ft. ; breadth, 21 ft. ; depth, 11·9 ft. Number of watertight compartments, 4. The engines are inverted cylinder direct-acting , and compound. The ship will carry about 400 tons of cargo, and is classed A 1 100 (the highest) at Lloyd's. She is furnished with Hudson & Cobbet's patent four-bladed propeller.

William Hinde.—On the 20th October there was launched from the shipbuilding-yard of Messrs. Workman, Clarke & Co., Belfast, an iron screw-steamer for Mr. Wm. Hinde, coal merchant of that town. The name of the *William Hinde* was given to the vessel in the customary manner by Mrs. Hinde. Immediately afterwards the vessel was towed round to the Prince's Dock, where she will receive her engines and boilers. The length of the *William Hinde* is 160 ft. ; breadth, 22 ft. 6 in., and is upwards of 500 tons burthen. She is schooner-rigged, has been built under special survey, and is classed 100 A 1 at Lloyd's. Her engines are made on the newest principle, and her boilers work up to 80 lbs. pressure. The *William Hinde* is to be employed in the coal trade between Whitehaven and Belfast.

TRIAL TRIPS.

Dallam Tower.—On the 28th September the *Dallam Tower* (s) had a satisfactory trial of her engines at sea. She is a steamer of 2,054 tons gross register, built by Messrs. M. Pearse & Co., of Stockton-on-Tees, for Messrs. Stumore, Weston & Co., of Liverpool and London. Her dimensions are as follows :—Length, 295 ft. ; breadth, 35·3 ; depth, 24·6. Her engines which are supplied by Messrs. Blair & Co., of Stockton, are of 250-horse power nominal. She is fitted with steam steering gear and all modern improvements, and is intended for the Atlantic and East Indian trade. A speed of 11¼ knots was obtained at the measured mile. At the conclusion of the trial she proceeded on her voyage to Norfolk (U.S.A.).

Crosby.—On the 30th September the screw steamer *Crosby* of Newcastle, one of Messrs. Smith's Blue Cross Line of vessels went to sea for her trials, after the large alterations which have recently been made in her. The *Crosby*, which was built in 1870, was originally 233 ft. long, 33 ft. 6 in. beam, 17 ft. 3 in. depth of hold, and her registered tonnage was 1,118 tons nett, 1,498 tons gross. She has since been lengthened by 38 ft. amidships, which makes her length 271 ft., the work of lengthening being carried out at Messrs. Smith's Dock, North Shields. She is now capable of carrying 2,600 or 2,700 tons of cargo. The engine power, owing to the enlargement of the vessel, has been correspondingly increased, entirely new engines and boilers having been put in by Messrs. Hawkes, Crawshay & Company, Newcastle. Besides the addition of new machinery she has been thoroughly overhauled, repainted, fitted, &c. ; in fact the *Crosby* is a new vessel. She is destined for the Atlantic, Indian, and general trades. The vessel left the harbour about 7 a.m., and cruised about off the Tyne for the adjusting of the compasses. About 10 o'clock a steam tug left the New Quay, North Shields, with a party of gentlemen, and proceeding out to sea some distance off the bar, drew alongside the *Crosby*, and allowed the party to board her. After the arrival of the party on board, the vessel was swung for another hour or so, and then she was taken over the measured mile off Whitley. The engines throughout the day worked smoothly and without hitch of any kind. They are of the usual building, containing all the recent improvements. The cylinders are 33 and 63 in. diameter, 40 in. stroke. During the trial over the mile they worked at a speed of 78 revolutions per minute, and with a pressure of 80 lbs. in the boilers the indicated horse power was 1,178. The course was gone over three times, with a result of 11¾ knots per hour.

Ingerid.—On the 30th September, from the yard of Messrs. Raylton, Dixon, & Co., there proceeded to sea on her trial trip the *Ingerid* (s), the launch of which we noticed a short time ago, and which has been built to the order of a Rotterdam firm, and is intended principally for the trade between that port and Bergen, in Norway. Her length is 183 ft., breadth 24·6, depth 14 ft., and she will carry 560 tons. The engines, of 60-horse power nominal, are by Messrs. T. Richardson & Sons, of Hartlepool, and they worked to the eminent satisfaction of builders and inspectors, giving a result of 9¾ knots an hour, which is considerably in excess of her guarranteed speed. She is fitted with accommodation for 16 first-class passengers amidships, and is well adapted for the trade in which she is intended to run.

Franklin.—The trial trip of the screw steamer *Franklin*, built and engined by Messrs. David and William Henderson & Co., for the Spencer's Gulf Steamship Company, of Adelaide, South Australia, took place on the Clyde on the 2nd October. The result of the several runs made on the measured mile was a speed of 12½ knots per hour, which was considered highly satisfactory. The machinery worked during the whole day very smoothly.

Otway Tower.—On October 8th the *Otway Tower* (s) ran her trial off the Tyne. She has been built by Messrs. Wigham, Richardson & Co., of Newcastle-on-Tyne, and is of the following dimensions :—Length, 290 ft. ; breadth, 35 ft. 3 in. ; depth, 25 ft. 6 in. ; classed 100 A 1 Lloyd's, under special survey of hull and machinery. She is constructed on the three-decked rule, and fitted with water ballast on the bracket system, has short poop and topgallant forecastle, and is covered in amidships for one-fourth of her length, affording protection to her machinery in heavy weather, and providing shelter for cattle or deck passengers. Special facilities are afforded for the rapid working of cargo, and the vessel is steered from amidships by Higginson's patent steam-steering gear. She has lofty 'tween decks, 8 ft. high, suitable for carrying troops or cattle, carefully ventilated, and all holds are fitted with special apparatus for extinguishing fire. The engines also by Messrs. Wigham, Richardson, & Co., are of the following dimensions :—Cylinders, 31 and 62 in. diameter by 48 in. stroke, designed to indicate, when under full steam, 1,000-horse power. The boilers, of Siemens Martin steel, are constructed for a working pressure of 90 lbs. to the square in. On the measured mile she averaged 11 knots per hour, the high pressure engine indicating 487, and the low pressure 492, making a total of 979-horse power, the pressure at the time being 84 lbs., vacuum 27½ in., and revolution 64. This result was attained in the face of a strong N.E. wind and heavy beam sea. This vessel owned by Messrs. Stumore, Weston & Co., of Liverpool and London, is intended for the American and East Indian trades. Though not intended for the passenger trade, the ship has passed the Board of Trade survey of hull, machinery, and outfit, and carries a passenger certificate. At the conclusion of the trial the steamer proceeded on her voyage to the United States.

Duchess of Edinburgh.—The official trial of the paddle steamer *Duchess of Edinburgh* took place on October 9th, and resulted in a speed of nearly 18 knots or 21 miles. The *Duchess of Edinburgh* was also supplied for her trial trip, by Messrs. Cory Brothers & Co., with the same new coal—the Penrikyber Navigation Upper Four Feet—which is evidently destined to become a favourite among Steamship Owners.

Livadia.—The official trials of the Czar's yacht *Livadia* took place on October 8th and 9th, and gave a speed of 16 knots and 12,383 indicated horse-power. The trials were conducted under the inspection of an imperial commission appointed for the purpose, consisting of Admiral Licachoff, the president, who was accompanied by Captain Linden, of the Russian Embassy of London, and the following :—Captain Vogack, the captain of the *Livadia*, General Sokoloff, Captain Kasy, Captain Verhovskoi, and Captain Goulaeff. Admiral Popoff was still unable to be present owing to his continued illness. There were also present Dr. Tideman, chief constructor of the Dutch Navy, who had tested the models of the *Livadia* ; Mr. Van Raalte, the acting Russian Consul, and Sir William Thomson ; and on Saturday Mr. James Dunn, one of the constructors of the Navy, also attended. Mr. Pearce, the head of the firm of Elder & Co., the builders, conducted the trials ; and Mr. Bryce, the manager of the engine department, had charge of the engines. The trials on October 8th consisted of a six hours' continuous run at sea. The course extended from the Tail of the Bank to the south of Arran, the time being taken at the Clocks Light and the Cumbrae Light, a run of about 13·66 miles. The trial showed a speed of 15 knots by the lights, and 15½ by log. It extended from half-past 12 to half-past 6, and, as the contract required only 14 knots the result was eminently satisfactory. On October 9th the revolutions were taken during the whole of the run and indicator diagrams every half hour, showing an average of 10,500 horse power. The trials consisted of six runs on the measured mile, and resulted as follows :—The first, 16 knots ; the second, 15·652 ; the third, 16 ; the fourth, 15·755 ; the fifth, 16 ; and the sixth, 15·755 ; showing a mean for the six runs against wind or tide of 15·864 knots. The results here given were recorded by a chronograph of the Admiralty pattern. There is no question but the first-rate quality of the coal supplied—which was from the Penrikyber Navigation Upper Four Feet, a new seam, the property of Messrs. Cory Brothers & Co., of Cardiff—very materially contributed to the exceedingly satisfactory results obtained. The Glasgow agent of Messrs. Cory Brothers & Co. has just received from the builders of the yacht a letter stating:—"We are highly satisfied with the Penrikyber coal you supplied to us for the *Livadia*. It is without exception the best coal we have ever used." It is said that the yacht will consume about 100 to 110 tons per day, and that if the furnaces are fed to their utmost capacity the consumpton will not exceed 190 tons. After the trials the party dined in the ward room of the yacht. After dinner, Mr. Pearce, the constructor of the yacht, in asking the company to drink success to the *Livadia*, said that they were now entering on a new phase in the construction of large steamers. Passengers were now no longer content with 10 or 15 knots an hour, and the great problem for the naval architect was to find out the proper form for a ship to go, not merely from 16 to 18, but from 20 to 25 knots an hour. They had not only a fast and agreeable ship, but they had obtained a very steady platform and a high rate of speed for war vessels. (Hear, hear.) During the last 12 years progress in the construction of war vessels had not been as great as it should have been, considering what strides had been made in the manufacture of iron, steel, and other materials, and also the great improvements that had taken place in marine engineering. They had that day carried out an experiment which, notwithstanding the prejudices hitherto entertained against it, must be a guide in respect of many points in the future. It would be said, "Look at the displacement of your ship and the enormous amount of horse-power;" but they must remember in the construction of war ships that the first consideration was a steady platform; the question of speed was secondary. The *Livadia* had been subjected to an extraordinary amount of criticism. In the first place, the design had excited the opposition of the leading constructors of ships of war in Great Britain. Some of them had gone so far as to ridicule the idea altogether, and when he expressed a hope that he should get 14 knots an hour out of the ship, he was laughed at. Among the critics the Russian papers had been the most inveterate. Reading some of these papers he found they said that the ship was tried three weeks ago, and that she only went seven knots an hour—a statement which was copied into a great many of the papers in Europe. He declared that a more successful ship than the *Livadia* had never been built, and he congratulated Russia and the Grand Duke Constantine on being the first to take up this bold enterprise, when our own Admiralty dared not venture. He asked them to drink success to the *Livadia* and the health of Admiral Popoff, her designer. Captain Goulaeff, who replied, was sure he expressed Admiral Popoff's feelings when he said that Mr. Pearce, having been bold enough to undertake the construction of the ship, should now enjoy all the credit for the result.

Duchess of Edinburgh.—The official trial of this steamship, intended for the Channel service between Folkestone and Boulogne, took place on October 12th in the Clyde. She is 250 ft. long, 39½ ft. broad, and 15 ft. deep, with 368 nett tonnage. Six runs were made on the measured mile, and the ship attained a mean speed of 17·677 knots, or about 20¼ statute miles per hour. The mean horse power developed was 2,750. The *Duchess of Edinburgh* has been built and engined on the compound principle by Messrs. Jas. & Geo. Thompson, of Clyde Bank Foundry.

Annie.—The trial trip of the iron screw-steamer *Annie*, built to the order of Mr. Rodenacker, of Dantzic, by Messrs. C. S. Swan & Hunter, Wallsend-on-Tyne, took place on October 13th. Dimensions: 201 ft. long, 28 ft. 6 in. broad, 15 ft. 7 in. deep; engines, 26·49 by 30 stroke and 75 lb. pressure, constructed by Messrs. Black, Hawthorn & Co., Gateshead. The vessel and machinery have been built to the highest class at Lloyd's, under special survey. The trial trip was attended by Messrs. Bremer, Bennett & Bremer, of London, representing the owner. The vessel attained a good speed, and the trial was considered in every respect satisfactory.

Starley Hall.—On October 16th the *Starley Hall* (s), a new iron screw steamer of 600 tons, built by Messrs. Ramage & Ferguson, Leith, for the London and Edinburgh Shipping Company, went out on her trial trip. After adjusting compasses, the vessel was run a given distance to test her speed, with the most satisfactory results, an average of about 11 knots being maintained. The engines, which have been made by Messrs. Fleming & Ferguson, Paisley, worked very smoothly, and 84 revolutions per minute was easily kept up. On her return the *Starley Hall* was at once placed on the loading berth for London.

Dom Alfonso.—On the 16th of October the trial trip of the *Dom Alfonso*, paddle-wheel steam vessel, built at the Thames Iron Works, Blackwall, for the South-Eastern Railway Company, took place. The *Dom Alfonso* is sister ship to the *D. August*, built for the same department three years ago. Her dimensions are:—Length between perpendiculars, 156 ft.; beam. 18 ft.; with draught of 4 ft. 6 in., and her mean speed on the measured mile was 13¼ knots. She is fitted with oscillating surface-condensing engines of 250-horse power by Messrs. Young & Son, of Blackwall. After a successful trial Mr. Hayward, the manager of the Thames Iron Company, handed over the vessel to Captain Vaz, the representative of the Portuguese Government.

Loch Rannoch.—For the trial trip of a new steamer the weather on the morning of October 18th, was all that a landsman could desire. There was little or no wind, the air was mild and even balmy, and the water was smooth as a mill pond. Under these happy auspices the latest and largest addition to the Loch Line of steamers began her trial trip some miles out to sea and back to the Tay. At half-past ten o'clock in the forenoon a large company, invited by the managing owners, Messrs. Ireland & Leitch, met on board the steam-tug *Iron King* at the Camperdown Dock, Dundee, and were conveyed on board the *Loch Rannoch*, which was lying off in the Roads. The guests numbered upwards of 200. The tug having been cast off and the anchor weighed according to nautical custom, the *Loch Rannoch* herself was soon under "weigh" and steaming down the river. The quiet sea and bright sunshine proved evanescent, for no sooner had the crew of the lightship saluted the *Loch Rannoch* than a strong north-easterly breeze began to blow and rain to fall. At this time the steamer, instead of continuing her course to the Bell Rock and the Island of May, was put about and made again for the Tay. The sky became overcast, and there was every appearance of disagreeable weather. With many on board there were all sorts of speculations as to what had caused the course of the vessel to be altered—some saying that a "screw" was loose, while others averred that it had been discovered that the band which was to provide music for the dancing had been left behind. The latter proved the more correct speculation, and while the *Loch Rannoch* was steaming back to the Ferry to take the missing fiddlers on board, luncheon was served on the main deck by a staff of active waiters to a company of guests whose appetites had been whetted by the invigorating breeze. The steamer meanwhile had again been put about, and her course was headed for the Bell Rock, which was soon approached at a speed of something near 12 knots an hour. The average speed attained during the trip was 12¼ knots an hour, and the engines wrought with admirable smoothness. The run was continued for a few miles beyond the Bell Rock, when the *Loch Rannoch* again headed for the Tay, and Dundee Harbour was reached shortly after six o'clock. Those on board enjoyed themselves as thoroughly as the unfavourable state of the weather would permit. Everything on board is on the most modern principle, and, so far as put in operation yesterday, was found to work with the utmost regularity. Among the appliances adopted in the *Loch Rannoch*, and not previously noticed, are the block bushes of the British and Foreign Metaline Company. It is claimed for metaline that it is a composition which serves all the purposes for which oil is used in ordinary machinery bearings, and that it causes the bush to work sweetly, without heating, even when a heavy strain is on it. All the latest improvements were carefully inspected yesterday by those on board the *Loch Rannoch* in the intervals when the wind and rain would allow, and the criticisms passed were most complimentary to the builders and to the owners of the vessel.

Assyrian Monarch.—The trial trip of this magnificent vessel took place lately with very satisfactory results. The vessel was commenced in October, 1879, under the instructions of the Royal Exchange Shipping Company (Limited), and was rapidly brought to completion by Messrs. Earle & Co. The launch took place in the presence of many eminent and scientific men on the 10th of August, when the most satisfactory expectations were entertained of the vessel's future usefulness and success. Since then, through the energy and personal supervision of its commander, Captain Westhorp, the ship has been made ready to take its place among the splendid fleet of the line to which it belongs. The lines were laid with the strictest regard to the purposes of the trade for which the vessel is specially prepared. The large and increasing traffic with America in cattle, as well as grain and provisions, has brought into existence lines of steamers for the rapid transit of the flocks and herds of that country to our shores. Those intending to be present at that trip left by the tug *Liverpool* in a shower of hail. The managing director of the Royal Exchange Shipping Company

Mr. Jacob Vickers, brought a large party with him. In a quarter of an hour the tug arrived at Earle's Mud Dock, where Wilson's large new steamer lies ready for launching, and Captain Longley's screw steamer *Yorkshire*. At a quarter to ten we left the Mud Dock Pier and steamed across the Humber. Shortly after ten o'clock we approached the stern of the *Assyrian Monarch*. The Company's house flag flies at the main-masthead, and the ensign at the flagstaff. She stands out of the water at 16 ft.; five feet above her water line. Iron doors divide the ship into air-tight compartments. Proceeding aft we find accommodation for 540 head of cattle, to be accompanied by more than 560 sheep. Coal bunks for 1300 tons of coal are below; the daily consumption is over 40 tons for the three boilers, The saloon is very handsome, with ample room for twenty or thirty dinners at a time. Passing Spurn Point, Kelsey Beacon, Easington Church, and Dunlington, we came off Withern-in-Sea, in sight of the measured mile, and the result of the test is that the vessel makes 12·86 knots, or between 14 and 15 miles an hour. This is first rate, for the vessel tries these conclusions with yards square, and the screw five feet higher than will be the case when her cargo is in her. The Royal Exchange Shipping Company was represented by Mr. J. J. Vickers, of Messrs. Patton, Vickers, & Co., London, and Earle's Shipbuilding Company by Mr. H. S. Broderick, the general manager; Mr. A. E. Seaton, of the engineering department; and Mr. George Cole, manager of the building yard. There were also present:—Captain Wann, Mr. Esplen, of Liverpool, the consulting engineer, who had superintended the construction of the splendid engines; Mr. Spear, Mr. Macneil, Mr. G. S. Goodwin, Mr. J. E. Weir, Mr. J. E. Bingham, senior warden of the Cutlers' Company, Sheffield; Captain and Mrs. Longley, Captain Hume, and other gentlemen.

Ville de Cette.—The new screw steamer *Ville de Cette*, recently launched from the shipbuilding-yard of Messrs. Hodgson & Soulsby, Cowpen Quay, Blyth, had her trial trip on the 22nd October. The steamer left Blyth Harbour in the afternoon, and after a run along the Coast, the vessel put into the Tyne, the result of the trial being highly satisfactory to all parties. The engines, which are 130-horse power, are from the works of Messrs. Black & Hawthorn, Gateshead, and worked admirably. The steamer, which is about 1,500 tons burthen, is intended for the wine trade between Cette and Spain.

Colombo.—On October 16th the trial trip of a tug boat, built by Messrs. R. & H. Green, of Blackwall, for the Colombo Harbour Improvements, Ceylon, took place. This tug is intended for towing the dredging machine barges, and has been built to the specification of the harbour engineer, Sir John Coode. Her length is 60 ft., beam 14 ft., draught 6 ft. 6 in., and she is fitted with a pair of compound surface-condensing engines of 25 horse-power, made by Messrs. Alexander Wilson & Co., Vauxhall Iron Works, Wandsworth Road, London, S.W. The speed obtained was 9·56 knots per hour, the contract speed having been only 8 knots per hour.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

ANSWERS TO PROBLEM

ASKED BY "PUZZLED" IN OCTOBER NUMBER.

To the Editor of the MARINE ENGINEER.

SIR,—Subjoined is the solution of problem sent by "Puzzled" in your paper of last month. The question looks like one that would trouble some captain who wishes to make believe he knows "all" about engines, &c., or who is desirous of passing in steam. Those engineers who have not listened to a captain "explaining" the marine engine to passengers and others have missed a most exquisitely amusing treat. But why are not engineers allowed to pass in navigation as captains are in steam? The first engineer would then have authority to take charge of the ship in case of accident to the master. Many engineers are competent to do so, but have at present no Board of Trade authority to do so. I am very far from going the length that a great many now do in saying that the captain of a Channel steamer is only on a par with a railway guard.

By the question 100 in. = area of smallest or No. cylinder, and No. 2 cylinder has an area = to 1st + $\frac{1}{2}$ of No. 3 cylinder, and No. 3 cylinder has its area = to 1st + 2nd, and stroke is $\frac{1}{12}$ of the combined areas. What is the diameter of each cylinder and stroke in inch?

$\sqrt{\frac{100}{\cdot7854}} = 11\frac{9}{32}$ in. the diameter of No. 1, or smallest cylinder.

Let $2x$ = area of No. 3 cylinder, and $100 + x$ will = area of No. 1 + $\frac{1}{2}$ of No. 3s = area of No. 2 cylinder.

$\therefore 2x = (100 + x) + 100.$

$\therefore \quad x = 200.$

Then $100 + x = 300$ in. the area of No. 2 cylinder and $\sqrt{\frac{\cdot300}{\cdot7854}} = 19\frac{17}{32}$ in. the diameter, and $2x = 400$ in. the area of No. 3 cylinder, and $\sqrt{\frac{\cdot400}{\cdot7854}} = 22\frac{9}{16}$ in. the diameter, 800 in. = combined areas and $\frac{1}{12}$ of 800 = 66·6 in. the stroke.

I am Sir, your obedient servant,

D. HENDERSON.

Waterford, 18*th October*, 1880.

To the Editor of the MARINE ENGINEER.

SIR,—Having just seen in the MARINE ENGINEER of the 1st inst. a problem which has puzzled "Puzzled," I beg to send him the following solution according to the data given:—

Area of No. 1 piston .. .. = 100 sq. in.;
Then let that of No. 2 do. ... ... $= x$
That of No. 3 will consequently be $= x + 100$

$$x = 100 + \frac{100 + x}{2},$$

$$2x = 200 + 100 + x,$$

$$2x - x = 200 + 100,$$

$$x = 300 = \text{area of No. 2 piston.}$$

Then $100 + x = 100 + 300 = 400$ sq. in. = area of No 3 piston,

$$\frac{100 + 300 + 400}{12} = \frac{800}{12} = 66{\cdot}66 \text{ ins.} = \text{length of stroke.}$$

$$\sqrt{\frac{100}{\cdot7854}} = 11{\cdot}28 \text{ in.} = \text{diameter of No. 1 cylinder.}$$

$$\sqrt{\frac{300}{\cdot7854}} = 19{\cdot}54 \text{ in.} = \quad ,, \quad \text{No. 2} \quad ,,$$

$$\sqrt{\frac{400}{\cdot7854}} = 22{\cdot}56 \text{ in.} = \quad ,, \quad \text{No. 3} \quad ,,$$

I am, Sir, yours obediently,

SIMPLE.

Southampton, *October 9th*, 1880.

To the Editor of the MARINE ENGINEER.

SIR. — Will the following be a satisfactory solution of "Puzzled's" problem contained in your last issue?

1st Piston = 100"
2nd ,, = 1st + $\frac{1}{2}$ of 3rd.
3rd ,, = 1st + 2nd.
Stroke = $\frac{1}{12}$ of combined area.

1st Piston = A.
2nd ,, = B.
3rd ,, = C.

$A = 100''$
$B = A + \frac{C}{2}$
$C = A + B.$

$$C = A + B = 100 + \left(100 + \frac{C}{2}\right) = 200 + \frac{C}{2} = 400.$$

$$B = A + \frac{C}{2} = 100 + \frac{400}{2} = 300.$$

$$\text{Combined area} \begin{cases} A = 100'' \\ B = 300'' \\ C = 400'' \end{cases} \qquad \text{Stroke} = \frac{800}{12} = 66.6''.$$

800"

Yours truly,

A SUBSCRIBER.

Waterford, *Oct. 21st*, 1880.

To the Editor of the MARINE ENGINEER.

DEAR SIR,—The following will, I believe, be the solution of the problem that has puzzled "Puzzled."

Let x = area of 1st cylinder; y = area of 2nd cylinder; z = area of 3rd cylinder.

Then by question we have $x = 100, x + \frac{z}{2} = y, x + y = z$.

Transposing we have

$$\left.\begin{array}{l} x \qquad\quad = 100 \\ \text{B}\left\{\begin{array}{l} x - y + \frac{z}{2} = 0 \\ x + y - z = 0 \end{array}\right. \end{array}\right\} \text{A}$$

Solving we have values of A and B.

$$\left.\begin{array}{l} y - \frac{z}{2} = 100 \\ -2y + \frac{3z}{2} = 0 \end{array}\right\}$$

Equalizing we have

$$\left.\begin{array}{l} 2y - z = 200 \\ -2y + \frac{3z}{2} = 0 \end{array}\right\} = \left\{ \frac{z}{2} = 200 \quad \therefore z = 400. \right.$$

To find value of y take the equation $x + y - z = 0$.

Then $100 + y - 400 = 0$; $y = 400 - 100$; $y = 300$.

Then $x = 100$ square inches = 1st cylinder.

$y = 300$ „ „ = 2nd „

$z = 400$ „ „ = 3rd „

$$\text{Diameter of 1st cylinder} = \sqrt{\frac{100}{\cdot 7854}} = 11{\cdot}2''.$$

$$\text{Diameter of 2nd cylinder} = \sqrt{\frac{300}{\cdot 7854}} = 16{\cdot}7''.$$

$$\text{Diameter of 3rd cylinder} = \sqrt{\frac{400}{\cdot 7854}} = 22{\cdot}5''.$$

Stroke in inches

$$\frac{100 + 300 + 400}{12} = \frac{800}{12} = 66\tfrac{2}{3}'' = 5'\ 6\tfrac{2}{3}''.$$

I think there is some mistake about the stroke, and that the true meaning is "$\frac{1}{12}$ of the combined area in square feet," the result to be inches of stroke. For if it were to be as "Puzzled" has put it the stroke would be

$$\frac{100 + \overset{25}{300^*} + 400}{12^*} = 525'' = 43{\cdot}75 \text{ feet.}$$

which, of course, is ridiculous.

Trusting that the above is not too long,

I am yours faithfully,
T. H. BALL.

7, Ogle Terrace, Southwick,
October 20th, 1880.

* These figures are to cancel.

[Mr. Ball has taken a liberty in the way in which he has cancelled the last fraction, which has entirely altered the result.—ED. M.E.]

To the Editor of the MARINE ENGINEER.

SIR,—I think "Puzzled" will find the following the correct solution of his difficulty.

Yours, &c.,
E. J. CLARK.

Let x = area of 3rd piston.

Then No. 1 = 100, No. 2 = $100 + \frac{1}{2}x$.

$\therefore x = 100 + (100 + \frac{1}{2}x) = 200 + \frac{1}{2}x = 400$

$$\begin{array}{lr} \text{1st} = & 100 \\ \text{2nd} = 100 + 200 = & 300 \\ \text{3rd} = 100 + 300 = & \underline{400} \\ & 800 \end{array}$$

$\frac{1}{12}$ of $800 = 66\frac{2}{3}$ = stroke.

October 14th, 1880.

To the Editor of the MARINE ENGINEER.

SIR,—In answer to your correspondent I send the following answer to his problem.

VERITAS.

Let x denote the area of No. 3 cylinder, and y the area of No. 2 cylinder.

Then $x = y + 100$ … … … 1

and $y = \frac{x}{3} + 100$ … … … 2

Now substitute for y in signature No. 1 the value of y, thus—

$x = \left(\frac{x}{3} + 100\right) + 100$ … … 3

Clear of fractions, thus—

$3x = x + 300 + 300$ … … … 4

By reduction—

$2x = 600$ … … … … 5

Therefore $x + 200$ … … … 6

To find the value of y substitute for x in equation No. 2 the value of x, thus—

$y = \left(\frac{y + 100}{3}\right) + 100$ … … … 7

Clear of fractions, thus—

$3y = y + 100 + 300$ … … … 8

By reduction, thus—

$2y = 400$ … … … … 9

Therefore $y = 200$ … … … 10

Area of No. 1 cylinder … 100 inches.

„ No. 2 „ … 200 „

„ No. 3 „ … 300 „

Total amount … 600

$$\text{Length of stroke} = \frac{600}{12} = 50 \text{ inches.}$$

["Veritas" has made a mistake in his statement. $2y$ by hypothesis $= \frac{x}{2} + 100$.—ED. M.E.]

Reviews.

Transactions of the Institution of Naval Architects.

A further very interesting summary of the proceeds of the Institution of Naval Architects is now before us as Vol. XXI. for 1880. The opening address of the President, Lord Hampton, scans very clearly and succinctly the subjects at present of general interest to naval architects. Amongst other points of interest he refers to the subject of the introduction of steel into ship building, and to the possibility of rendering our mercantile marine most readily available for national defence at sea in the case of war. A most interesting paper follows by B. Martell upon "The Cause of Unseaworthiness in Merchant Steamers." These causes of unseaworthiness are classified as—1. Weakness of Structure. 2. Deterioration. 3. Absence of Proper Control over Cocks or Valves. 4. Faulty and deficient pumping arrangement. 5. Breaking down of machinery. 6. Bad Navigation. 7. Inefficient Protection of Openings in the Deck. 8. Hasty and Improper Loading. 9. Disproportionate Dimensions. 10. Overloading. The other most noticeable papers are "On the True Nature of the Resistance of Armour of Shot," by John Scott Russell; on "The Cellular Construction of Merchant Ships," by W. John, Esq., and "On Steel in the Shipbuilding Yard," by W. Denny. As this last-named gentleman has had excellent opportunities of seeing the action of steel in actual construction, his paper is full of very interesting details. It seems that his firm are now almost exclusively employed on steel, nor do they seem to have found much difficulty in handling the steel, as they have very few failures in manipulations to report. This volume of Transactions is a most valuable collection of the latest information in shipbuilding matters, and type and plates are all that could be desired.

Notes and Novelties.

FIVE new screw steamers have been booked on the Clyde for a new French Shipping Company to ply between that country and American ports. They are to be similar in tonnage and general build to those recently constructed for the Compagnie Générale Transatlantique of France. J. Elder & Co. in a few days will lay the keel of a new Australian liner for the Orient Steam Navigation Company to ply between London and Australia.

IT is stated that a company is getting up in Sheffield to start a fast line of steamers to run between England and America. The expectation of the promoters of the company is that boats can be built of such a class as to make the passage in six days, and contracts have already been issued by the company for the building of five large steamers which are to have engines capable of driving them at the speed of 19 knots per hour.

IRON shipbuilding on the Tyne continues very brisk, as soon as vessels get launched their places are reoccupied with the commencement of new vessels, and in most of the Tyne yards orders on hand and being executed, will keep all hands well employed during the autumn and most of the winter.

THE keels of two new vessels have lately been laid down in Devonport yard. Upon completion they will be named *Heroine* and *Hyacinth*. They are of an improved *Mutine* class, being 20 ft. longer and 2 ft. wider than that class of vessels, and carrying eight guns in lieu of six mounted by the *Mutine*. The increased length and breadth give an them addition of 296 tons displacement, the tonnage being 1,420, as against 1,124. For building and completing hull an estimate of £45.000—£20,000 for material and £25,000 for labour—has been approved.

THE THUNDERER GUN.—The committee which assembled at Malta to investigate the cause of the explosion of a 12-in. gun on board Her Majesty's ship *Thunderer* recommended in their report that the fellow gun of the *Thunderer* should be sent to England in order to be subjected to a series of tests, concluding by firing it with a double charge. This recommendation, having been approved by the Admiralty and the Secretary of State for War, was referred to the Special Committee on Ordnance to be carried out; and it will be remembered that the gun so experimented upon was burst by the double charge fired from it on the 3rd of February last. A detailed report of their experiments has been prepared by the committee, and has just been issued as a Parliamentary paper. Until the double charge was fired, the results attained were of a comparatively unimportant character, and may be summed up by saying that an air space between the powder and the projectile notably diminished, while a wad placed at some distance in front of the projectile did not notably increase the pressure upon the bore of the gun. In speaking of the results of the double-loading, the committee offer a lengthened "hypothetical description of the various phenomena of the burst, taking them in their order from the ignition of the charge to the final destruction of the gun." They then sum up in the following brief opinion, signed by Major-General Gordon, R.A., the president:—"The committee consider that the circumstances of the burst afford the strongest possible confirmation of the views taken by the Malta Committee as to the cause of the accident on board Her Majesty's ship *Thunderer*."

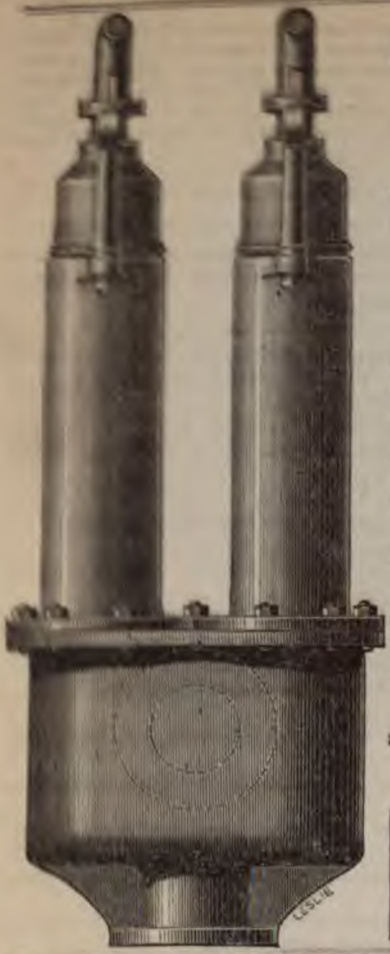
THE *New York Times* records the death of the well-known shipbuilder, Donald M'Kay, and adds:—"Mr. M'Kay did the main part of the work upon which his reputation was founded between the years 1848 and 1856. During that period he built 40 or 50 clipper ships after models that were far superior to anything then known. One of the ships, the *Flying Cloud*, made the voyage from Boston to San Francisco in 89 days, and though the ship *Northern Light* made the same trip, though in the opposite direction, in 79 days, yet, taking the course followed and the trade winds into account, the former passage indicated the possession of sailing qualities nearly, if not fully, equal to the latter. Another of M'Kay's ships, the *Sovereign of the Seas*, made in 24 hours a run of 430 miles, which indicated a rate of speed which few steamers at the present time could surpass. But what deserves particular attention was the shipbuilding that Mr. M'Kay did on foreign account. His reputation having been established for constructing fast vessels, orders poured in on him from abroad. The managers of several of the packet lines from England to Australia supplied themselves with ships built at East Boston, which were, at the time far ahead of any that could be constructed in Great Britain. The *Lightning*, the *Champion of the Seas*, the *James Baines*, and a dozen other ships, each having a tonnage of 2,000 tons and upwards which was then looked upon as enormous, were all built expressly for the Australion packet trade. Americans proved at that time that they could outstrip the English in shipbuilding, and had not the serviceability of iron then been discovered, it is more than probable that shipbuilding on the coast of New England would now be as active an industry as it is on the Clyde, for we had the same advantage in constructing wooden hulls that the English have in building iron ones. Where the English were wiser than we was in freely buying our ships. When they found that we had a superior article they did not hesitate to avail themselves of it. Instead of giving up the carrying trade of the sea to us, as we have to them, they continued to hold it by making our shipbuilders supply them with the best vessels that could be obtained, and hence they were at all times on a plane of equality with us. It is singular that with all our regret over our lost ocean commerce we have never seen fit to imitate the shrewd example sent us by our English rivals."

AN important Naval and Marine Engineering Exhibition, under the auspices of the Lord Provost and Town Council and a committee of the leading shipbuilders and engineers, opens in Glasgow on the 1st of November, and will remain open until April. Lord Ravensworth, President of the Institution of Naval Architects, will declare the Exhibition open, and the opening is to be marked by a conversazione.

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 17th September to 18th October, 1880.

3772 G. Allix. Iron frames and planking for composite ships.
3777 H. Montgomerie. Propelling vessels, dispensing with use of ordinary marine engine.
3805 J. Christie. "Southwester" or sailors' hat.
3816 H. E. Newton (communicated by D. Davison). Steam generators.
3820 C. C. Braithwaite. Lubricators.
3826 P. Brotherhood. Apparatus for launching torpedoes.
3828 T. O'Hara. Steam and hydraulic moters.
3849 W. R. Lake (communicated by H. G. Ashton). Safety valves.
3883 W. Prowett. Apparatus for production of motive power.
3921 W. M. Brown (communicated by F. M. Stevens and J. H & C. C. Pearson). Steam generators, valves, &c.
3927 G. Howard. Operating or hauling in fishing nets.
3949 J. Teer. Smoke consumer.
3965 J. Scott. Apparatus for raising, lowering and disengaging ships' boats or cargo.
3989 B. Tower. Indicating and directing by signal the speed of engines, &c.
3998 H. Tonkinson & W. Rockliffe. Metal door frames for use in iron ships.
3999 J. Taylor. Appliances for taking in, stopping, and stowing wire, &c.
4002 J. Salter. Steam generators.
4021 H. Eaton. Engine cylinders.
4033 J. J. & T. L. Galloway. Discharging ash from steamboats.
4042 A Steenberg. Recording ships' course (communicated by F. Alsing and others).
4044 G. F. Corliss (communicated by G. H. Corliss). Steam engines.
4048 H. F. Phillips. Driving screw propellers.
4066 Pde Wrady & K. O'Kouneff. Steam generators.
4085 J. Evans. Anchors.
4086 H. J. Haddan (communicated by Prosper Privat). Steam boiler.
4096 J. Dean. Grate bars.
4109 A. Noble. Ordnance.
4117 R. W. Perkins & J. F. Flannery. Furnaces.
4122 S. H. Linn. Construction of chambers for preserving food, and regulation and control of temperature.
4130 A. M. Clarke (communicated by J. F. Guild & A. E. Knight). Steering apparatus.
4131 A. W. L. Reddie (communicated by R. M. Fryer). Construction of Navigable vessels and propulsion in water or on land.
4135 W. M. Brown (communicated by S. M. Richardson). Breech loading ordnance.
4155 H. J. Haddan (communicated by W. Von Pittler). Steam generator and engine.
4182 J. Neil. Furnaces, &c., for burning and utilizing hydro-carbon oils, &c., for heat, &c.
4213 R. B. Jones & J. Hughes. Clips or brakes for steel wire, &c., also applicable for winches and hauling.
4229 M. Pratt. Motor engines.

⁂ Any information regarding the progress, &c., of these patents will be gladly furnished on application.



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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

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The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

The Marine Engineer,

LONDON, DECEMBER 1, 1880.

EDITORIAL NOTES.

THE voyage of the *Livadia*, which seems for the present to have come to a termination at Ferrol, has been the occasion of a very interesting communication from Sir E. J. Reed. The damage done to the bows of the submerged hull does not, in itself, seem to have been of much importance, as a couple of days in an English dock-yard would have sufficed, in Sir E. J. Reed's opinion, for putting her to rights. At the Spanish rate of work this has lengthened out to three weeks; and now the Czar has left the Crimea, and the yacht is no longer required there for the present. It has thus been determined that the *Livadia* shall winter at Ferrol. Much as this enforced detention will appear to invidious critics to imply unseaworthiness on the part of Admiral Popoff's design, there can be no doubt from Sir E. J. Reed's report that the *Livadia* is in every way, so far, a complete success. Her steadiness even in a rough seaway, such as she experienced in the Bay of Biscay, was remarkable and equal to the most sanguine expectations. The dinner was laid as in fair weather without protection against violent movements, and even the promenade in an outside verandah was equally comfortable and refreshing as in calm weather. The Czar is certainly much to be envied for his possession of such a yacht, if only from the point of view of comfort in rough weather. Why should not the travelling British public share in such benefits in their excursions across the Channel? A fleet of such steamers would do much to remove the terrors of the Channel crossing from the mind of even the most timid voyager. In speed also the *Livadia* has come up to such a high standard, even in rough weather, as to promise an excellent comparison with any vessel of her own displacement and power of the usual form. As a floating battery the steadiness of such a hull as that of the *Livadia* would be invaluable, and its shallow draught would be of the greatest service for manœuvring in shallow estuaries such as the Thames or the Mersey. We cannot do less than endorse Sir E. J. Reed's statement, that Admiral Popoff may rest assured that in the *Livadia* he has initiated a great and valuable improvement in the forms of ship.

WE are glad to see that the continual hammering at the Government, carried on by ourselves and other technical journals, seems now to be bearing fruit in the question of our heavy ordnance. We understand that, at last, a proper independent technical committee is to be appointed to report on changes contemplated in the Land Ordnance Service, and in the armament of the Navy. The committee will consist of artillery, naval, and engineer officers, and we are glad to see one or two eminent mechanical engineers from the civilian ranks of the profession. This now begins to look something like business, and to promise that no good inventions, wherever they come from, will be pushed aside without investigation by he prejudice of a Government official. It is further stated that no officers of the Government manufacturing establishments will be appointed on this committee. It is almost inconceivable that any government or the country can have been satisfied with the conclusions of any officer or body of officers who have been called upon to decide between the merits of their own pet inventions and those of outside competitors. It is not in human nature to be unbiassed under such circumstances. It is to be hoped that when the committee in question have arrived at a conclusion as to the best system of ordnance, no time will be lost in supplying such improved arms to our ironclads and forts, so as no longer to leave them in the present deplorable condition of being worse armed than those of other Continental nations.

AN entirely new class of ocean steam-tug has just been added to the navy. The only vessel fitted to act either as tug-tender to a fleet, or dispatch boat has latterly been the old paddle-steamer *Valorous*, which is now on its last legs. Messrs. Laird, of Birkenhead, however, conceived that such a class of steamers could be built to prove most powerful tugs, and at the same time sufficiently fast for ordinary despatch and tender purposes. A design was thus prepared by them, and tendered to and accepted by the Admiralty. The result is a new steam-tug the *Sea-horse*, of 160 feet in length, and 26 feet in beam, and 519 tons measurement, which has passed through a most satisfactory trial in the Solent. She is fitted with two sets of direct acting inverted compound engines, containing all the latest improvements, each set driving a four bladed iron propeller. The engines have each one high pressure cylinder 26 inches in diameter, and one low pressure cylinder 45 inches in diameter, with a stroke of 2 feet 6 inches. The boiler pressure is also exceptionally high, viz., 75 lbs., and the engines on the trial indicated a mean horse-power of 1·165 horses, with a resulting speed of 12·6 knots per hour. As this was a continuous trial, and not alone on the mile trial, it must be considered highly satisfactory, and we should think well calculated to ensure several further orders of the same type from the very successful makers.

EXHIBITIONS seem to be quite the order of the day. We give a description elsewhere of an exhibition at the Agricultural Hall, London, held during last month, at which several exhibits of interest to the Marine Engineering world were shewn. Glasgow also, last month, has thrust herself prominently into notice with a very good exhibition of Naval and Marine Engineering. We should like to see such a special exhibition initiated in London. We think it would receive good support. The Glasgow Exhibition is not of the temporary character to which we are accustomed, but will remain open until the end of April. The collection of models of hulls are very instructive and interesting, comprising as it does such extreme specimens as that of the *Great Harry*, built in the reign of Henry the Eighth, the *Victory*, the *Great Britain*, the *Comet*, the first steam vessel afloat on the Clyde, the *Scotia*, once the finest paddle-ship afloat, and *Cleopatra*, built for the transport of the Obelisk to England, and which shows the "needle" fixed in the interior. In another room are models of engines, boiler fittings, screw propellers, and the like; and the interest of the visitors is well sustained by a complete series of exhibits of models of lighthouses and the lighting arrangements. Nor are diving-bell, life-saving, dredging apparatus unrepresented. The exhibition will well repay a visit from those interested in such matters.

IT seems that the Admiralty are far from satisfied with their late experiment of offering a premium of £200 for every quarter knot realized by second-class torpedo boats beyond the contract speed of 15 knots an hour. We think if they had acted on good technical advice, any engineer could have told them that there were many dodges by which a temporary exceptional speed could be obtained, that were not at all likely to be serviceable in practice. It seems that this is now being discovered, and that the test now required will, at least, extend over a period of three hours continuously.

A SIMPLE arrangement has been adopted in the *Dreadnought* to obviate the possibility of a mis-fire not being noticed by the gunner. It is evident from the case of the *Thunderer*, that no reliance can be placed upon the observance of the gunner of the absence of the explosion and recoil in the case of mis-fire. In the surrounding noise of the other great guns, and the excitement even of a sham action, the gunner's impressions are not to be relied on. The apparatus in question is simply a lock by which the hydraulic lever used to run back the gun for re-loading is held fast until the gun has naturally recoiled 18 inches. In this way the absence of recoil absolutely prevents re-loading until the charge is fired. The application of the same species of lock would, we think, be of value if applied to all the successive actions of raising the lift and shot, and revolving the turret, or running out the gun.

OUR attention has been drawn to a very grave anomaly in the respective formulæ used by the Board of Trade and Lloyd's, to determine the pressure that can with safety be carried on a boiler flue of given dimensions and thickness. Lloyd's rule will permit of nearly twice as much pressure in many cases as that of the Board of Trade.

The formula used by Board is $p = \dfrac{60{,}000\, t^2}{(l + 1) \times d}$

That of Lloyd's is ... ... $p = \dfrac{89{,}600\, t^2}{l \times}$

and our readers may easily ascertain for themselves the wide difference of the safe working pressures deduced from these two alternative formulæ when t is the thickness of plate, l the length in feet, and d the diameter in inches. We shall be very glad to hear from any of the engineers at Lloyd's or the Board, as to the grounds upon which these formulæ are formed. For if one is right, the other must be egregiously wrong; and in the meantime the marine engineers and the ship-owners suffer from either dangerous weakness of flues, if on the basis of Lloyd's formulæ, or from vexatious interference on the part of the Board from its point of view. Which is it?

EXPERIMENTS WITH THE STEAM-CUTTER OF THE UNITED STATES STEAMSHIP "PENSACOLA."

From the Journal of the Franklin Institute.

By Chief Engineer ISHERWOOD, U. S. Navy.

THE experiments described in this article were made with the steam-cutter of the United States steamship *Pensacola* by the writer during the time he was Chief Engineer of the Mare Island Navy Yard, California.

The principal object of the experiments was to ascertain the law of the variation of the resistance of the hull in function of its speed; incidental to which there was obtained the maximum power which the machinery could develop, and the corresponding speed of the vessel.

Before proceeding to the experimental data and to the analysis of their results in the cases of the different experimental speeds, there must be given the dimensions, proportions, etc., of the hull and of its machinery, and a description of the manner in which the data were obtained and the results deduced.

The cutter was an open boat constructed at the Mare Island Navy Yard, of wood, and sheathed with copper.

HULL.

Extreme length		38 ft. 1 in.
Length from forward edge of rabbet of stem to after side of sternpost, on load water-line ...		35 ft.
Extreme breadth on load water-line		8 ft. 11 in.
Depth from lower edge of rabbet of keel to top of gunwale at middle of length		4 ft. $3\frac{1}{2}$ in.
Depth from lower edge of rabbet of keel to load water-line ...	Forward	1·600 ft.
	Mean ...	2·175 ft.
	Aft ...	2·750 ft.
Depth of keel below the lower edge of its rabbet	Forward	0·400 ft.
	Mean ...	0·575 ft.
	Aft ...	0·750 ft.
Draught of water to load water-line	Forward ...	2 ft.
	Mean ...	2 ft. 9 in.
	Aft ...	3 ft. 6 in.
Area of greatest immersed transverse section to load water line		12·53 sq. ft.
Area of load water line		207·62 sq. ft.
Area of the immersed external surface of the hull to load water-line		332·85 sq. ft.
Displacement to load water-line		269·00 cub. ft.
Displacement to load water-line		7·700 tons.
Displacement per inch of draught at load water-line		0·4953 ton.
Ratio of the area of the greatest immersed transverse section to the area of the circumscribing parallelogram		0.6461
Ratio of the area of the load water-line to the area of the circumscribing parallelogram ...		0·6653
Ratio of the displacement to the circumscribing parallelopipedon		0·3963
Ratio of the length to the breadth on the load water-line		3 9252
Angle of dead-risê at the greatest immersed transverse section		$22\frac{1}{2}$ degrees.
Weight of the hull and its fittings		6,270 pounds.

ENGINES.

There are two vertical, direct-acting, non-condensing engines one placed immediately behind the other, with the axes of the cylinders in the same vertical plane with the axis of the shaft. Each cylinder has a three-ported slide valve, unbalanced, and worked direct from the shaft by means of an eccentric and its rod. The valve of the forward cylinder is upon its after side, and of the after cylinder, upon its forward side. The starting and reversing are effected by turning the eccentrics to stops upon the shaft, by means of a mitre-gear and hand-wheel at the centre of the engines. Both cylinders are bolted to a horizontal flat plate of cast iron that forms their bottoms and is supported upon four cast iron standards which are bolted in turn to a bed-plate secured to the hull—two standards at each end of the bed-plate. The inner sides of each pair of standards are formed into guides for the crosshead. There are but two main pillow-blocks, and they are bolted to, and supported upon the bed-plate. The forward crank-pin is overhung. There is one plunger feed-pump, vertical, at the forward end of the bed-plate and supported upon it. This pump is worked direct from a pin in the crosshead of the forward engine. The distance between the axes of the cylinders is 22 in. The cylinders and their valve-chests are without covering of any kind. The eccentrics are between the engines, and each one is directly below the valve-stem to which its rod is attached. The exhaust steam is delivered into the chimney of the boiler and forms an artificial draught. There is a heater for the feed-water which is heated by the exhaust steam to about 75 degrees Fahrenheit above the temperature of the sea-water whence it is taken.

The following are the principal dimensions:—

Number of cylinders	2
Diameter of cylinders	6 in.
Diameter of piston-rods	$1\frac{1}{8}$ in.
Stroke of pistons	6 in.
Area of both pistons, exclusive of area of piston-rods	55·554 sq. in.
Space displacement of both pistons per stroke ...	0·1919 cu. ft.
Breadth of steam port	$\frac{5}{8}$ in.
Length of steam-port	4 in.
Area of steam-port	2·5 sq. in.
Breadth of exhaust-port	$\frac{7}{8}$ in.
Length of exhaust-port	4 in.
Area of exhaust-port	3·5 sq. in.
Diameter of connecting-rod in necks	$1\frac{3}{16}$ in.
Diameter of connecting-rod between centres ...	1 ft. $2\frac{13}{16}$ in.
Diameter of crosshead journal...	$\frac{7}{8}$ in.
Length of crosshead journal	$1\frac{1}{2}$ in.
Diameter of crankpin journal of after engine ...	2 in.
Length of crankpin journal of after engine ...	$2\frac{1}{2}$ in.
Diameter of crankpin journal of forward engine ...	$1\frac{3}{8}$ in.
Length of crankpin journal of forward engine ...	2 in.
Diameter of main journals	$2\frac{1}{2}$ in.
Length of main journals	$2\frac{1}{2}$ in.
Width of eccentric straps	1 in.
Diameter of eccentric rods	$\frac{3}{8}$ in.
Diameter of feed pump (single acting and for both engines)	$1\frac{1}{4}$ in.
Stroke of feed-pump plunger	6 in.
Diameter of valves (poppets) of feed pump ...	1 in.
Number of thrust collars	5
Inside diameter of thrust collars	$2\frac{1}{2}$ in.
Outside diameter of thrust collars	$3\frac{3}{8}$ in.
Width of thrust collars	$0\frac{1}{2}$ in.
Length of crosshead guide-gibs	3 in.
Breadth of crosshead guide-gibs	2 in.
Thickness of side of cylinders	$0\frac{5}{8}$ in.
Thickness of plate to which cylinders are bolted ...	$1\frac{3}{16}$ in.
Thickness of bed-plate	$1\frac{1}{4}$ in.
Length occupied by the engines in the forward and aft direction of the vessel	3 ft. $6\frac{1}{4}$ in.
Breadth occupied by the engines in the athwartship direction of the vessel	2 ft. $3\frac{5}{8}$ in.
Height of the engines above the bottom of the bed-plate	3 ft. 6 in.

BOILER.

There is one boiler of the locomotive type, with iron tubes in direct continuation from the furnace to the chimney.

The front portion of the boiler is rectangular in plan with a semi-cylindrical top. The length of this portion is 2 ft. 10 in.; breadth, 3 ft. 6 in., and height, 4 ft. Upon its top, at its centre, is a cylindrical steam-chest, 18 in. in diameter and 18 in. high. This front portion contains the furnace, 2 ft. 3 in. long, 3 ft. wide, and 2 ft. high above the top of the grate. The furnace top is horizontal;

Claudius.—On the 21st October Messrs. Joseph L. Thompson & Sons launched from their shipbuilding yard, North Sands, an iron screw steamer built to the order of Mr. Thomas Kish and partners, of Sunderland. The vessel is of the following dimensions, viz.:—Length, 260 ft.; breadth, 36 ft.; depth of hold, 18 ft. 6 in., with a dead-weight carrying capacity of 2,250 tons. The naming of the vessel *Claudius* was performed by Miss Kish, sister of the managing owner. The *Claudius* is intended for the Atlantic and Mediterranean trades.

LAUNCHES.—SCOTCH.

Janet M'Neil.—On the 5th October Messrs. Russell & Co., launched at Port Glasgow an iron sailing barque of the following dimensions:—Length, 194 ft.; breadth of beam, 32 ft. 6 in.; depth of hold, 19 ft. 7 in.; and 900 tons. She was named the *Janet M'Neil* by the wife of one of the owners. This barque has been built for Messrs. Brown & Watson, Glasgow, and when fitted out she will load in Glasgow for the East.

Express.—On the 5th inst. Messrs. D. & W. Henderson & Co., launched from their shipyard at Meadowside, Partick, a steam tender of the following dimensions:—Length, 150 ft.; breadth, 25 ft., for Messrs. Henderson Brothers, of the Anchor Line. The ceremony of naming the tender the *Express* was performed by Miss Meiklereid, daughter of the well-known Superintendent of the Line.

Marana.—On the 5th inst. Messrs. Aitken & Mansel launched from their Whiteinch yard, near Glasgow, a screw steamer of about 2,300 tons register, for Messrs. George Bell & Co., of Liverpool, for their Liverpool and South American trade. This vessel, which received the name *Marana* from Miss Bell, has been built under the supervision of Messrs. M'Kaig & Stott, engineers, Liverpool, and will be fitted with machinery of 250-h.p. by Messrs. John & James Thomson, Finnieston Foundry, Glasgow.

Castellano.—On the 6th October, Mr. Robert Chambers, jun., launched from his yard at Dumbarton, the screw steamer *Castellano*, a sister ship to the *Filipino*, launched a few weeks ago. These vessels are built to the order of Messrs. Olano, Larrinaga & Co., Liverpool, for coasting among the Phillipines. They are 400 tons burthen, schooner-rigged, with decks of teak, and will be fitted with awning decks amidships, and canvas awnings fore and aft. The engines, compound surface-condensing, of 360-horse power indicated, are by Messrs. M. Paul & Co. and the vessels are expected to attain considerable speed. The *Castellano* was named as she left the ways by Miss Jane E. Thompson, Hawick.

Kerbella.—On the 6th October, Messrs. Wm. Denny & Brothers launched from their shipyard at Dumbarton the *Kerbella*, an iron screw steamship, of the following builders' dimensions:—235 ft. by 35 ft. by 26 ft. 6 in., and about 2,000 tons gross measurement for the British India Steam Navigation Company (Limited). She has been built to class 100 A 1 at Lloyd's, under special survey, and is to be fitted with compound surface-condensing direct-acting inverted-cylinder engines of 200-horse power nominal, by Messrs. Denny & Co. She is constructed on the continuous double-bottom system, so largely employed by her builders, and with deep plate frames on the sides. The *Kerbella*, on leaving the ways, named by Miss Frizell, daughter of Charles Frizell Esq., Castle Cavan, county Wicklow.

Leon XIII.—On the 7th October there was launched from the shipbuilding yard of Messrs. John Elder & Company, Fairfield, Govan, an iron screw steamship for the Marquis de Campo, called *Leon XIII.* The vessel is intended for the conveyance of the Royal mail, together with passengers, troops, and merchandise from Spain to Manila, taking her departure from Liverpool. Her principal dimensions are:—Length between perpendiculars, 315 ft.; breadth, 36 ft.; depth (moulded), 25 ft. 9 in.; and the gross tonnage 2,200. She has been built to the highest class at Lloyd's, under special survey, and her engines will be of the newest and most approved type, on the compound principle, with high-pressure cylinder 38 in., and low pressure 68 in. diameter, by 4 ft. stroke. The engines will be fitted with Messrs. Brown Brothers' combined steam and hydraulic reversing donkey engines. Steam will be supplied by two double ended cylindrical tubular boilers working up to 75 lbs. pressure. The indicated horse power will be 1,600. The vessel will have accommodation for 50 first-class passengers. Special attention has been devoted to the lighting and ventilation, each cabin having a large square port through ship's side; and, in addition to the ordinary cowl ventilators, a powerful fan, driven by a special engine, is employed to exhaust the foul air from the cabins; the same fan being also used to ventilate the second-class cabins and the soldier's quarters. Berths are provided for 30 second-class passengers on the main deck, and the cabins in which these are placed are large and well ventilated. The remaining portion of the main deck is fitted up for the accommodation of soldiers. The officers and crew are berthed on the upper deck, the former in deck-houses and the latter in the topgallant forecastle. The vessel is rigged as a three-masted schooner, with lower masts of iron. She is also fitted with patent steam windlass, powerful steam winches, fresh water condenser, steam pumps to each hold, in addition to the usual hand pumps, steering gear both aft and amidships, together with all other appliances for working the vessel and loading and discharging cargo. As the vessel left the ways she was named the *Leon XIII.*, by Mrs. De Pedrorena, wife of the Spanish Consul.

Maipu.—On the 18th October there was launched from the shipbuilding-yard of Messrs. John Elder & Co., Fairfield, Govan, a steel paddle steamer for the Argentine Republic. The vessel is intended for torpedo warfare, but may also be used for surveying purposes. Her principal dimensions are:—Length between perpendiculars, 240 ft.; breadth, 30 ft.; depth, moulded, 14 ft. 3 in.; her tonnage, B.M., being 1,062 tons. She will be propelled by two diagonal oscillating engines, one working each paddle-wheel, and for manœuvring purposes these are made capable of being connected or disconnected at will. The high-pressure cylinder of each engine is 30 in. in diameter, and the low pressure is 56 in. by 5 ft. 6 in. stoke. Steam is supplied by four steel single-ended boilers, working up to 75 lbs. pressure, and capable of driving the vessel at a speed of 15 knots an hour easily. She has two pole masts, is of light schooner rig, and has a ram bow. The whole of the 'tween decks is fitted up for the accommodation of the officers and crew, the magazines, store-rooms, shell-rooms, &c., being below. She carries one 40-pounder Armstrong steel breech-loading gun forward, while aft she has one Hotchkiss 5-barrelled 4-pounder gun and two other mitrailleuses. In addition to these her armament will consist of spar and Whitehead torpedoes. As she left the ways she was named the *Maipu* by Miss Francis, of Glasgow.

Phasis.—On the 20th October Messrs. Barclay, Curle, & Co. launched from their yard at Whiteinch, an iron sailing ship of 1,560 tons register, built of the highest class at Lloyd's, for Messrs. A. & J. H. Carmichael & Co., Greenock. As the ship left the ways she was named the *Phasis* by Miss Deans, of Braehead House, Stewarton, Ayreshire.

Buckhurst.—On the 21st October, Messrs. Archibald M'Millan & Son launched from their dockyard, Dumbarton, the sailing ship *Buckhurst*, which they have built for Messrs. W. R. Price & Co., London. The dimensions of the *Buckhurst* are the following:—277 by 40½ by 24 ft., the register tonnage is about 1,950 tons gross, and she is one of the largest carrying ships ever built, having a deadweight capacity of 8,300 tons. The *Buckhurst* is being fitted with every improvement the experience of her builders and owners can suggest for safety, efficiency, and economy of working in all details. The vessel was named by Mrs. M'Millan, Rockville, Dumbarton.

Cambrian.—On the 22nd October, Messrs. John Fullerton & Co., launched from their yard at Merksworth, Paisley, an iron screw steamer of 500 tons, built to the order of Messrs. J. & J. M'Farlane, Glasgow. She is to be supplied with compound engines of 60-horse power nominal, by Messrs. William King & Co., Dock Engine Works, Glasgow. As the vessel left the ways she was named the *Cambrian* by Mrs. James M'Farlane, Glasgow.

Ballochbuie.—On the 22nd October there was launched from the building-yard of Messrs. Hall, Russell & Co., Footdee, an iron screw-steamer of the following dimensions:—Length, 195 ft.; breadth, 31 ft. 6 in.; depth, 13 ft. 6 in.; gross register, 790 tons. The vessel has been built under special survey to class 100 A1 at Lloyd's, and will be fitted with compound surface-condensing engines of 85-horse power nominal, water ballast, steam winches, and other improved appliances for facilitating the loading and discharging of cargoes. The steamer has been built to the order of Messrs. J. & A. Davidson, and is intended for the Baltic and Mediterranean trades. She will be under the command of Captain Macdonald, late of the *Benamain*. As she was leaving the ways she was named the *Ballochbuie* by Mrs. Jamieson, wife of the Lord Provost of the city. The *Ballochbuie* forms the eleventh vessel of Messrs. Davidson's "B" line of steamers.

Valencia.—On the 23rd October, Messrs. Henry Murray & Co. launched from their yard, at Kingston, an iron screw steamer, built for Messrs. Goodyear & Co., of Liverpool, and intended for the Mediterranean trade. The dimensions of the *Valencia* are 175 ft. in length between perpendiculars by 25 ft. 6 in. beam by 12 ft.

11 in. depth of hold. She registers 344 tons nett, and classes in Lloyd's highest grade. The vessel, which is to be commanded by Captain George Pearce, will be fitted by Messrs. James Howden & Co., Glasgow, with a pair of 80 nomnial horse-power compound engines.

LAUNCH.—Irish.

Parkmore.—On the 4th October, at Belfast, Messrs. MacIlwaine & Lewis launched a screw-steamer named the *Parkmore*, of the following dimensions :—Length over all, 160 ft. ; breadth, 21 ft. ; depth, 11·9 ft. Number of watertight compartments, 4. The engines are inverted cylinder direct-acting , and compound. The ship will carry about 400 tons of cargo, and is classed A 1 100 (the highest) at Lloyd's. She is furnished with Hudson & Cobbet's patent four-bladed propeller.

William Hinde.—On the 20th October there was launched from the shipbuilding-yard of Messrs. Workman, Clarke & Co., Belfast, an iron screw-steamer for Mr. Wm. Hinde, coal merchant of that town. The name of the *William Hinde* was given to the vessel in the customary manner by Mrs. Hinde. Immediately afterwards the vessel was towed round to the Prince's Dock, where she will receive her engines and boilers. The length of the *William Hinde* is 160 ft. ; breadth, 22 ft. 6 in., and is upwards of 500 tons burthen. She is schooner-rigged, has been built under special survey, and is classed 100 A 1 at Lloyd's. Her engines are made on the newest principle, and her boilers work up to 80 lbs. pressure. The *William Hinde* is to be employed in the coal trade between Whitehaven and Belfast.

TRIAL TRIPS.

Dallam Tower.—On the 28th September the *Dallam Tower* (s) had a satisfactory trial of her engines at sea. She is a steamer of 2,054 tons gross register, built by Messrs. M. Pearse & Co., of Stockton-on-Tees, for Messrs. Stumore, Weston & Co., of Liverpool and London. Her dimensions are as follows :—Length, 295 ft. ; breadth, 35·3 ; depth, 24·6. Her engines which are supplied by Messrs. Blair & Co., of Stockton, are of 250-horse power nominal. She is fitted with steam steering gear and all modern improvements, and is intended for the Atlantic and East Indian trade. A speed of 11¼ knots was obtained at the measured mile. At the conclusion of the trial she proceeded on her voyage to Norfolk (U.S.A.).

Crosby.—On the 30th September the screw steamer *Crosby* of Newcastle, one of Messrs. Smith's Blue Cross Line of vessels went to sea for her trials, after the large alterations which have recently been made in her. The *Crosby*, which was built in 1870, was originally 233 ft. long, 33 ft. 6 in. beam, 17 ft. 3 in. depth of hold, and her registered tonnage was 1,118 tons nett, 1,498 tons gross. She has since been lengthened by 38 ft. amidships, which makes her length 271 ft., the work of lengthening being carried out at Messrs. Smith's Dock, North Shields. She is now capable of carrying 2,600 or 2,700 tons of cargo. The engine power, owing to the enlargement of the vessel, has been correspondingly increased, entirely new engines and boilers having been put in by Messrs. Hawkes, Crawshay & Company, Newcastle. Besides the addition of new machinery she has been thoroughly overhauled, repainted, fitted, &c. ; in fact the *Crosby* is a new vessel. She is destined for the Atlantic, Indian, and general trades. The vessel left the harbour about 7 a.m., and cruised about off the Tyne for the adjusting of the compasses. About 10 o'clock a steam tug left the New Quay, North Shields, with a party of gentlemen, and proceeding out to sea some distance off the bar, drew alongside the *Crosby*, and allowed the party to board her. After the arrival of the party on board, the vessel was swung for another hour or so, and then she was taken over the measured mile off Whitley. The engines throughout the day worked smoothly and without hitch of any kind. They are of the usual building, containing all the recent improvements. The cylinders are 33 and 63 in. diameter, 40 in. stroke. During the trial over the mile they worked at a speed of 78 revolutions per minute, and with a pressure of 80 lbs. in the boilers the indicated horse power was 1,178. The course was gone over three times, with a result of 11¾ knots per hour.

Ingerid.—On the 30th September, from the yard of Messrs. Raylton, Dixon, & Co., there proceeded to sea on her trial trip the *Ingerid* (s), the launch of which we noticed a short time ago, and which has been built to the order of a Rotterdam firm, and is intended principally for the trade between that port and Bergen, in Norway. Her length is 183 ft., breadth 24·6, depth 14 ft., and she will carry 560 tons. The engines, of 60-horse power nominal, are by Messrs. T. Richardson & Sons, of Hartlepool, and they worked to the eminent satisfaction of builders and inspectors, giving a result of 9¾ knots an hour, which is considerably in excess of her guarranteed speed. She is fitted with accommodation for 16 first-class passengers amidships, and is well adapted for the trade in which she is intended to run.

Franklin.—The trial trip of the screw steamer *Franklin*, built and engined by Messrs. David and William Henderson & Co., for the Spencer's Gulf Steamship Company, of Adelaide, South Australia, took place on the Clyde on the 2nd October. The result of the several runs made on the measured mile was a speed of 12½ knots per hour, which was considered highly satisfactory. The machinery worked during the whole day very smoothly.

Otway Tower.—On October 8th the *Otway Tower* (s) ran her trial off the Tyne. She has been built by Messrs. Wigham, Richardson & Co., of Newcastle-on-Tyne, and is of the following dimensions :—Length, 290 ft. ; breadth, 35 ft. 3 in. ; depth, 25 ft. 6 in. ; classed 100 A 1 Lloyd's, under special survey of hull and machinery. She is constructed on the three-decked rule, and fitted with water ballast on the bracket system, has short poop and topgallant forecastle, and is covered in amidships for one-fourth of her length, affording protection to her machinery in heavy weather, and providing shelter for cattle or deck passengers. Special facilities are afforded for the rapid working of cargo, and the vessel is steered from amidships by Higginson's patent steam-steering gear. She has lofty 'tween decks, 8 ft. high, suitable for carrying troops or cattle, carefully ventilated, and all holds are fitted with special apparatus for extinguishing fire. The engines also by Messrs. Wigham, Richardson, & Co., are of the following dimensions :—Cylinders, 31 and 62 in. diameter by 48 in. stroke, designed to indicate, when under full steam, 1,000-horse power. The boilers, of Siemens Martin steel, are constructed for a working pressure of 90 lbs. to the square in. On the measured mile she averaged 11 knots per hour, the high pressure engine indicating 487, and the low pressure 492, making a total of 979-horse power, the pressure at the time being 84 lbs., vacuum 27½ in., and revolution 64. This result was attained in the face of a strong N.E. wind and heavy beam sea. This vessel owned by Messrs. Stumore, Weston & Co., of Liverpool and London, is intended for the American and East Indian trades. Though not intended for the passenger trade, the ship has passed the Board of Trade survey of hull, machinery, and outfit, and carries a passenger certificate. At the conclusion of the trial the steamer proceeded on her voyage to the United States.

Duchess of Edinburgh.—The official trial of the paddle steamer *Duchess of Edinburgh* took place on October 9th, and resulted in a speed of nearly 18 knots or 21 miles. The *Duchess of Edinburgh* was also supplied for her trial trip, by Messrs. Cory Brothers & Co., with the same new coal—the Penrikyber Navigation Upper Four Feet—which is evidently destined to become a favourite among Steamship Owners.

Livadia.—The official trials of the Czar's yacht *Livadia* took place on October 8th and 9th, and gave a speed of 16 knots and 12,383 indicated horse-power. The trials were conducted under the inspection of an imperial commission appointed for the purpose, consisting of Admiral Licachoff, the president, who was accompanied by Captain Linden, of the Russian Embassy of London, and the following :—Captain Vogack, the captain of the *Livadia*, General Sokoloff, Captain Kasy, Captain Verhovskoi, and Captain Goulaeff. Admiral Popoff was still unable to be present owing to his continued illness. There were also present Dr. Tideman, chief constructor of the Dutch Navy, who had tested the models of the *Livadia* ; Mr. Van Raalte, the acting Russian Consul, and Sir William Thomson ; and on Saturday Mr. James Dunn, one of the constructors of the Navy, also attended. Mr. Pearce, the head of the firm of Elder & Co., the builders, conducted the trials ; and Mr. Bryce, the manager of the engine department, had charge of the engines. The trials on October 8th consisted of a six hours' continuous run at sea. The course extended from the Tail of the Bank to the south of Arran, the time being taken at the Clocks Light and the Cumbrae Light, a run of about 13·66 miles. The trial showed a speed of 15 knots by the lights, and 15½ by log. It extended from half-past 12 to half-past 6, and, as the contract required only 14 knots the result was eminently satisfactory. On October 9th the revolutions were taken during the whole of the run and indicator diagrams every half hour, showing an average of 10,500 horse power. The trials consisted of six runs on the measured mile, and resulted as follows :—The first, 16 knots ; the second, 15·652 ; the third, 16 ; the fourth, 15·755 ; the fifth, 16 ; and the sixth, 15·755 ; showing a mean for the six runs against wind or tide of 15·864 knots. The results here given

Speed of the vessel in geographical miles per hour.	Power of the speed in which the vessel's resistances increased from one experimental speed to the next greater.
6·50 6·75	3·7571
6·75 7·00	4·0756
7·00 7·25	4·5708
7·25 7·50	4·4190
7·50 7·75	4·3990
7·75 8·00	3·9225

According to the above, the power of the speed in which the vessel's resistance gradually increased from one experimental speed to the next greater, gradually rose until it became a maximum at the speed of 7·25 geographical miles per hour, from which to the speed of 8·00 geographical miles per hour it gradually declined.

During the different experiments the trim of the vessel changed with each change of speed, and in a very marked manner; the bow rising and the stern falling with each increase of speed. Notwithstanding the sharpness of the bow, the vessel, even at her lowest speed, carried a wide and high wave before her.

At the lowest speed there was a hollow or marked depression in the water a little abaft the stern, followed immediately by a corresponding wave or elevation of water above the general level, and with each increase of speed this hollow became deeper and deeper, and farther and farther from the stern, while the wave which followed it became higher and higher, and also more and more distant. At the highest speed the gunwale at the stern of the cutter was below the general level of the water, so that the persons sitting in the stern sheets appeared to an observer on shore to be standing waist-deep in the water, the cutter's stern being invisible.

There was not only this great alteration of the vessel's trim observed, but also that she began at medium speed to rise bodily above her mean draught of water when at rest, the bow becoming disproportionately high out of water.

The above phenomena, no doubt, exist for all vessels, be their size and form what they may, when their speed exceeds the limit at which their resistances increase in the ratio of the squares of the speeds; but this limit being farther and farther removed as the hull has greater length and finer form, is not in large and well-modelled vessels reached with the ordinary speeds of practice; but when even such vessels are driven beyond the speed of about 12 geographical miles per hour the appearances described make their influence felt.

The first cause of this marked change of trim with the increasing speeds of the cutter was the shortness of her after body comparably with her draught of water aft. Now, the water replacing at the vessel's after body that which was displaced at her fore body, comes from the plane of greatest pressure, which is the plane passing horizontally through the lower edge of the rabbet of the keel, and it rises solely by the force of gravity, the weight of the adjoining column of water measured from the plane referred to up to the water level, forcing it upwards, and it rises with the same velocity, no matter what may be the vessel's speed. But, as the vessel's speed increases, the ascending mass of water cannot reach the after body in time to support it in the position it had when at rest, and, consequently, this after body must drop until it does meet the ascending mass of water, and obtains thereby sufficient floatation. The greater the speed of the vessel, the farther the after body must drop, and with each dropping the resistance of the vessel must increase. As long, however, as the speed of the vessel is such, relatively to her length of after body and draught of water aft, that the ascending mass of water can reach the after body in time, there will be no dropping at the stern, and the vessel's resistance up to that speed will be in the ratio of the squares of the speeds.

The phenomena, as regards the bow, are influenced by the length of the fore body relatively to the speed. The displaced water rises vertically (that being its line of least resistance) along the sides of the fore body, and spreads out over the general level, the height of the rise and the area for the spreading out being measured, other things equal, by the length of the side of the fore body. When the speed of the vessel is increased to such a degree that the wave of translation does not move swiftly enough to keep out of the way of the vessel, the latter rises upon it as upon an inclined plane, and emerges bodily above her mean draught of water when at rest, thus offering a less external wetted surface and a less greatest immersed transverse section to be driven by the engines. In this way the decreased power of the speed in which the resistance of the vessel increased at the higher rates of speed may be explained.

The resistance of the hull is composed of two parts; one, that of her external immersed or wetted surface; the other, that of her form abstracted from this surface resistance. The first may be called her resistance in function of surface, and the last her resistance in function of form. The first may be approximated with reasonable accuracy by calculation; the last must be ascertained experimentally.

The experiments with the *Pensacola's* steam-cutter allow this separation of these two resistances to be made in her case, and each to be ascertained for the different experimental speeds of the vessel.

The speed with which the watery molecules glide over the wetted surface of the hull is less than the speed of the vessel, owing to the inclination of her lines to her longitudinal axis, and, in the case under examination, these two speeds may be taken to be in the ratio of 0·974 to 1·000. Assuming the wetted surface not to change in area during the experiments, it is 332·85 square ft., each square foot of which, when moving with the velocity of 10 ft. per second, has the resistance of 0·45 pound, which resistance increases and decreases with the square of the velocity. Calculating with these data the resistance of the external immersed or wetted surface of the hull for each experimental speed, and deducting it from the resistance of the hull at each of these speeds (line 3 of the table), the remainder will be the resistance in function of form. And it is evident that, as the resistance in function of surface varies with the square of the vessel's speed, all the increased resistance above that ratio must be due to the form alone.

In the following table will be found the results of these calculations, the resistance of the vessel in function of surface and in function of form being given separately:

Speed of the vessel in geographical miles per hour.	Total resistance of the vessel in pounds.	Resistance of the vessel in function of surface alone, in pounds.	Resistance of the vessel in function of form alone, in pounds.	Per centum which the resistance of the vessel in function of surface is of her total resistance.	Per centum which the resistance of the vessel in function of form is of her total resistance.
6·50	272·859	171·484	101·375	62·85	37·15
6·75	314·348	184·965	129·383	58·84	41·16
7·00	364·516	198·445	166·071	54·44	45·56
7·25	427·914	213·590	214·324	49·91	50·09
7·50	497·109	228·402	268·707	45·95	54·05
7·75	574·166	243·846	330·320	42·47	57·53
8·00	650·413	259·723	390·690	39·93	60·07

The power of the speed of the vessel in which its resistances in function of form alone increased for each experimental increment of speed of one-fourth of a geographical mile per hour, is as follows;

Speed of the vessel is geographical miles per hour.	Power of the speed in which the vessel's resistances in function of form alone increased from one experimental speed to the next greater.
6·50 6·76	6·4745
6·75 7·00	6·8719
7·00 7·25	7·2727
7·25 7·50	6·6660
7·50 7·75	6·3047
7·75 8·00	5·2812

The quantities on line 22 of the tables show the proportion of the net horse-power developed by the engines applied to the screw shaft, which was utilized in the propulsion of the vessel. Thy consequently represent the relative economic efficiency of the screw, referred to the net horse-power, at the different speeds of vessel. Had the resistances of the vessel been in the ratio of the squares of its speeds, the quantities on line 22 would have been equal; the decrease of the screw's efficiency with the increase of the vessel's speed, is due to the fact that the resistance of the vessel

EXPERIMENTS WITH THE STEAM-CUTTTER OF THE UNITED STATES STEAMSHIP "PENSACOLA."

By Chief Engineer ISHERWOOD, U.S. Navy.

Table containing the Results of Experiments made with the Steam-Cutter of the United States Steamship "Pensacola," at the Mare Island Navy Yard, California, in December, 1870.

No. of Line.				a	b	c	d	e	f	g
1			Speed of the vessel per hour, in geographical miles of 6086 feet ...	6.50	6·75	7·00	7·25	7·50	7·75	8·00
2			Slip of the screw, in per centum of its speed	21·450	23·038	24·802	26·833	28·761	30·649	34·248
3			Thrust of the screw, in pounds, calculated from the piston pressure on lines 10 and 11	272·859	314·348	364·516	427·914	497·109	574·166	650·413
4			Double strokes of Engines' pistons, and revolutions of the screw, made per minute	157·3792	166·8047	177·0392	188·4532	200·2290	212·5335	224·5679
5	DISTRIBUTION OF THE INDICATED PRESSURE ON THE PISTONS.		Mean gross-effective or indicated pressure on the pistons, in pounds per square inch	34·0000	38·7578	44·4897	51·6866	59·5470	68·2997	76·9957
6			Pressure required to work the engine, *per se*, in pounds per square inch of pistons	2·0000	2·0000	2·0000	2·0000	2·0000	2·C000	2·00C0
7			Net pressure applied to the shaft, in pounds per square inch of pistons	32·0000	36·7578	42·897	49·6866	57·5470	66·2997	74·9957
8			Pressure absorbed by the friction of the load, in pounds per square inch of pistons	2·4000	2·7568	3·1867	3·7265	4·3160	4 9725	5·6247
9			Pressure expended in overcoming the resistance of the water to the surface of the screw blades, in pounds per square inch of pistons	3·4084	3·8228	4·3085	4·8792	5·5072	6·2057	6·9296
10			Pressure expended in the slip of the screw, in pounds per square inch of pistons	5·6192	6·9509	8·6806	11·0255	13·7250	16 8932	20·1363
11			Pressure expended in the propulsion of the vessel, in pounds per square inch of pistons	20·5760	23·2273	26 3139	30·0554	33·9988	38·2283	42·3051
12	DISTRIBUTION OF THE ENGINE POWER.	ABSOLUTE.	Gross-effective or indicated horses-power developed by the engines ...	9·0080	10·8835	13·2596	16·3977	20·0719	24·4370	29·1082
13			Horses-power expended in working the engines, *per se*	0·5299	0·5616	0·5961	0·6345	0 6741	0·7156	0·7561
14			Net horses-power applied to the shaft	8·4718	10·3219	12·6635	15·7632	19·3978	23 7114	28·3521
15			Horses-power absorbed by the friction of the lead...	0·6359	0·7741	0·9498	1·1822	1·4548	1.7791	2·1264
16			Horses-power expended in overcoming the resistance of the water to the surface of the screw blades	0·9018	1·0737	1·2837	1·5484	1 8571	2·2209	2·6200
17			Horses-power expended in the slip of the screw	1·4887	1·9523	2·5868	3·4970	4·6265	6·0444	7·6124
18			Horses-power expended in the propulsion of the vessel	5·4517	6·5218	7 8432	9·5356	11·4594	13·6770	15·9933
19		PROPORTIONAL.	Per centum of the net power applied to the shaft, absorbed by the friction of the load	7·50	5·50	7·50	7·50	7·50	7·50	7·50
20			Per centum of the net power applied to the shaft, expended in overcoming the resistance of the water to the surface of the screw blades	10·64	10·40	10·14	9·82	9·57	9·36	9·24
21			Per centum of the net power applied to the shaft, expended in the slip of the screw	17·56	18·91	20·43	22·19	23·85	25·48	26·85
22			Per centum of the net power applied to the shaft, expended in the propulsion of the vessel	64·30	63·19	61·93	60·49	59·08	57·66	56·41

ncreased in a higher ratio than the square of its speed, while the resistance of the watery fulcrum to the screw blades increased only in the ratio of the square of the number of their revolutions in equal time, and that the number of these revolutions, *cæteris paribus*, is in the direct ratio of the speed of the vessel; that is to say, if the resistance of the vessel is as the square of its speed, the number of revolutions of the screw in equal time will be as the speed of the vessel.

As the resistance which the screw experiences from its watery fulcrum, other things equal, is as the square of the number of its revolutions in a given time, and as the vessel's speed is as the number of revolutions made by its screw in equal time, provided the resistance of the vessel, increased as the square of its speed, then the resistances of the screw and of the vessel, in this case, would increase in the same duplicate ratio of the speed, and the slip of the screw would consequently remain constant, and its economic efficiency undergo no change. But if the vessel's resistance increased in a higher ratio than the square of its speed, the resistance of the screw remaining in the ratio of the square of its revolutions in equal time, then the slip of the screw would increase with increased speed of vessel, and become greater and greater as that speed become greater and greater, and the screw would have, in consequence of these increasing slips, less and less economic efficiency.

The loss of economic efficiency by the screw, primarily caused by increased slip, includes not only the loss due to the increased slip, *per se*, but also that which is due to the increased resistance of the water to the screw surface, or, in other words, to the increased skin resistance of the blades, because, in order that the vessel make a given speed, more revolutions of the screw will be required in equal time with the increased slip of the screw, whose corresponding surface loss will be as the squares of the number of revolutions made in equal time.

THE IMPERIAL YACHT "LIVADIA" AT SEA.

Communicated to the *Times* by Sir E. J. Reid, M.P.

THE performances of this extraordinary vessel have so immediate a bearing upon the future construction of steamships, both for war and for passenger purposes, that some observations upon her steam trials at the Clyde and her subsequent sea passages will doubtless be of interest to many of your readers.

In the articles published concerning the *Livadia* before her completion a higher speed than many expected was confidently predicted for her, and has since been realized. I myself feel some pride in this result, for, although I have had nothing whatever to do with the *Livadia* beyond once visiting her after her launch, and subsequently crossing the Bay of Biscay in her, I have for several years past publicly maintained that ships like the *Livadia*, of small length and immense breadth, could be driven at a high speed, and in maintaining this principle I have stood almost absolutely alone in England. Owing to the enterprise of the Russian Government, the matter has now been put to the test, and a ship of only 235ft. long and with a breadth (153ft.) twice that of the *Inflexible*, has at her very first trials, and under some temporary disadvantages, attained a speed of very nearly 16 knots an hour. The power exerted in producing this speed has doubtless been great in proportion to the displacement and section of the vessel, but there is not a greater, nor is there, I am bound to say, a more universal delusion among nautical people than the determination of what is called "economy" by such considerations alone. In the present instance, for example, what was required was to produce a vessel of high speed and of superior steadiness, with large accommodation suitable for an Emperor and his Ministers and suite, and if that has been accomplished with a given expenditure of steam power it is idle to say that the same steam power would have driven a larger and more expensive ship as fast. Economy consists in accomplishing your object by the easiest and cheapest method; the neglect of your object and the attainment of something you do not require is extravagance, however disguised. The disregard of this principle has in war-ship construction cost the nations of Europe many a million.

The *Livadia* as completed has more immersion than was contemplated at the time of her design, and I have ascertained the following figures:—

	Displacement.		Mid section.
As designed	4,000 tons	...	900 sq. ft.
As tried at measured mile	4,420 „	..	1,000 „
At departure from Greenock	4,720 „	...	1,075 „
At departure from Brest	5,070 „	...	1,150 „

The reason assigned for these increased immersions is that the experiments of Dr. Tideman at Amsterdam showed that in a ship of the *Livadia's* form the loss of speed from increased immersion was exceedingly small, and that consequently as the ship approached completion no objection was offered to increase of weight where increased conveniences were suggested, and that many additions were in this way made. For the same reason the quantity of coal taken on board first at Greenock, and afterwards at Brest, was only limited by other considerations. She left Brest with 850 tons of coals on board.

In view of the exhaustive discussion of the ship's probable speed with other vessels, it may be for the convenience of many readers, whose interest in the question is great, to say that while the immersion was greater than was anticipated, so also was the power developed. The figures on Captain Goulaeff's authority, compare with the actual figures of the subsequent trial as follows:—

	Displacement.	Section.	Average indicated horse-power
Data of July	4,000 tons ...	900 sq. ft.	10,500
Data of measured mile trials	4,420 „ ...	1,000 „	12,354

The mean speed of six runs was 15·884 knots.

It will be observed that the increases of power and immersion were nearly proportional. The performance of the *Livadia* at high speed was, therefore, between two and three knots per hour inferior to that of a long fine-lined frigate like the *Shah* of proportional size and power. This difference is so very small compared with what the nautical world has been predicting that the full-speed trials of the *Livadia* must be pronounced a splendid success, and a demonstration of the fact which few but myself recognized—viz., that very great breadth of ship is compatible with very high speed,

Before we left the Clyde Admiral Popoff showed me a letter in which he had pointed out some of the disadvantages under which the steam trials were made. The success of the ship as regards speed is so great as to render it needless to insist upon these disadvantages, in so far as she is herself concerned; but it is of great importance to science to have it remembered that it was at her very first trials that a vessel of her proportions steamed nearly 16 knots. The *Livadia* has three screw propellers, and while there was but little experience to guide the Admiral in selecting for them the best dimensions, &c., there was none to guide him in fixing their relative positions, pitches, and other conditions. It is also highly probable that even under the best conditions three screws may propel such a form of ship less efficiently than either two screws or one. In view of all the facts, therefore, it appears probable that the deficiency of speed which is solely due to the form and proportions of the hull, as compared with the best ships of ordinary form, is still less, much less than even the trials of the *Livadia* might at first sight suggest.

Like considerations to these will, of course, apply more or less to all the steam performances of the *Livadia* for the present, but it will nevertheless be instructive to observe briefly her ordinary steaming qualities. On the 14th of October, at her earliest essays at steaming, she steamed at 11 knots per hour with 2,969 indicated horse-power, 13 knots with 4,770 indicated horse-power, and 15 knots with 10,037 indicated horse-power. This was in smooth water. At sea, when the wind and waves were moderate, she has run over long distances since we left Greenock with about 4,500-horse power, at a speed varying from 12 to 13 knots. It is not easy to select other ships of approximately equal steam power and displacement combined, but two of our ironclads come near to the *Livadia*, and I will give the comparison between them:—

Name of ship.		Displacement.		Horse-power.		Speed.
Penelope	...	4,394 tons	...	4,703	...	12·7 knots.
Orion ...	...	4,700 „	...	4,000	...	12 „
Livadia...	...	4,420 „	...	4,770	...	13 „
Ditto	...	4,720 „	...	4,500	...	12½ „

The speed of the *Orion* given is only estimated, but that is of no consequence, because the object of this comparison is merely to show that the Russian *Popoffka*, modified as in the *Livadia*, are capable of steaming at ordinary speeds with moderate power, and by no means contrast absurdly, as some suppose, with all other ships.

I must now say a few words upon the behaviour at sea of this remarkable vessel. In several articles that have appeared of late the public have been advised not to expect too much from the sea-going performances of the *Livadia*. Her extreme lightness of structure has been pointed out, and the probability of her sustaining heavy shocks and great vibration has been mentioned. "When waves are encountered at high speed, and the speed of the oncoming waves is virtually added to that of the ship, the qualities of the *Livadia* will probably be put to by far the most serious tests that await them." This prediction has been literally fulfilled on our passage across the Bay of Biscay. It was fine when we left Brest, but we had only been a few hours at sea when the barometer began to fall and bad weather set in. It would have been prudent, perhaps, to have put back into Brest, considering the very light draught of our ship and the towering heights of deck palaces which are piled upon her lightly-built upper deck. But the Grand Duke Constantine, the Lord High Admiral of Russia, was on board, and considered the opportunity of thoroughly testing the vessel too fine a one to be lost, and we consequently steamed away into the very teeth of a Bay of Biscay gale, which steadily grew angrier and wilder as we advanced all Wednesday, and during that night and the following morning blew at its hardest, accompanied with very heavy seas indeed. The actual rolling and pitching of the *Livadia* at the height of the gale was exceedingly small, never exceeding 4 deg. for the single roll, or 7 deg. for the double roll or 5 deg. for the forward pitch, and 9 deg. for the double pitch, so to speak. This horizontal steadiness was most remarkable, and, while in very agreeable contrast with my experiences of the last three years at sea in ordinary ships, was full of significance as regards the possible steadiness of gun platforms in ships of war. When we at length had crossed the Bay and got out of the gale, and steamed into Ferrol, not the slightest damage of any description had been sustained (with an exception to be mentioned hereafter), either to the vessel or to her boats, palaces, furniture, crockery, or anything whatever. The dinner-table was laid, the candelabra stood upon it, and the meals were served throughout the voyage, exactly as if the vessel had been at anchor in port. The broad covered gallery which extends all round the open deck was never reached by the sea, and it was only during the worst of the weather that even spray invaded it. With a vessel of such very light draught (7ft.), in such gale, and with such high and lumpy waves, the blows of the sea under the flat bottom were at times tremendous; but the confidence of the Grand Duke in refusing to turn back was justified, and both Admiral Sir Houston Stewart, the Controller of the Navy, who was on board, and myself are indebted to his Imperial Highness for a most instructive piece of sea experience. Sailor as Sir Houston is, and intimate with the latest forms and details of naval construction, it was impossible, nevertheless, for him not to profit by this very exceptional voyage on this very exceptional ship.

Before entering Ferrol one of the small compartments forward was found to be filled with water, and it was soon discovered that one of the bow plates had been stove in, and the plates in the neighbourhood strained and made leaky. My own first impression was that the cellular bow had yielded to the direct impact of the sea during one of the most violent of the shocks which were felt; but a close inspection of the injuries led us to the conclusion that the bow had been struck by some floating wreckage. The injured parts have been temporarily repaired, and the ship is again ready for sea. As it is now, however, too late in the season for her to reach the Emperor's Crimean home before His Majesty leaves for St. Petersburg, it has been decided to send her back to Ferrol till the spring. This decision has been the more readily arrived at in consequence of the Grand Duke Constantine being compelled to proceed direct to the capital of Russia without further delay to resume his duties as President of the Council of the Empire, which is now in Session. It is not improbable that the enemies of the ship and of Admiral Popoff will seize this opportunity of attacking both, and will declare that the *Livadia* is incapable of proceeding further at present with safety. This is not, however, the case, and the cause of the detention is what I have above stated—viz., the fact that the object of sending her to the Crimea this year will disappear with the departure thence of the Emperor. Mr. Pearce, the builder of the ship, who created this large and costly construction, with its magnificent machinery, in the brief space of 11 months, with enormous exertions is, of course, deeply disappointed at the postponement of the remainder of the voyage, and would be delighted to proceed in her to-day to Gibraltar and the Black Sea; nor can I help sympathizing with his feelings. But the winter is upon us; the weather in this part of the world at this time of the year is very uncertain; we have had gale after gale, and sometimes even hurricanes outside, since we have been lying here; ships have several times turned back into Ferrol because of heavy seas outside; a schooner is at the present moment bringing into port the crew of a vessel that has foundered outside; and I do not think it would be reasonable to complain, even if I had the right to do so, of all possible care being taken at such a season of a vessel supplied with costly fittings, furniture, and appointments, which might possibly undergo injury or deterioration if she were detained much at sea by gales of wind. I do not think these considerations would have been conclusive were she a British Royal yacht, but they might have been, and it is well to assume that the Russian authorities know best their own business.

It is important, however, to the whole shipbuilding world to know exactly the kind and extent of the injury which the *Livadia* sustained at sea, and for this reason I will state the principal facts plainly. The ship is divided by watertight divisions into 106 compartments, and out of these six suffered. Of these, one only formed part of what may be called the ship proper—viz., the foremost starboard compartment of the double bottom. This had water in it, and it was from this circumstance alone that the existence of some injury was at first discovered. It has now been ascertained, however, that the ship's bottom under this compartment was really not itself injured beyond a very slight leakage or "weeping" passed a couple of loosened rivets. The foremost bulkhead received part of the shock which burst in the compartment before it, and it was from that compartment that the adjacent compartment was gradually filled. So far as the hull proper is concerned, therefore, no injury worth mentioning was sustained. But around the hull proper is a cellular rim, so to speak, forming the outer sides of the turbot. This rim is lightly framed and plated and is divided into a large number of small cells, which are treated as external to the ship herself, and have nothing whatever placed in them. Of these numerous small cells, five were more or less injured, two of them badly, and these have been temporarily stopped and strengthened by timber and shores. In one of them, where it was difficult because of rivets, angle irons, &c., to stop the leakage, a temporary inner bottom of plank has been laid and caulked.

The repairs being completed, his Imperial Highness and party steamed to-day in the *Livadia* from Ferrol to this port, thence to start upon his return journey to St. Petersburg. He may do so with the satisfaction of knowing that, besides much more than realizing her promised speed, the Imperial yacht came out of the Bay of Biscay gale and encountered to all appearances some heavy blows at the bow without any more serious injury than the damage of a few small outlying compartments, which are completely cut off from the interior and vital parts of the vessel.

I ought not to conclude without bearing my tribute of praise to the admirable manner in which this ship has been built on the Clyde. The iron work is everywhere "as sound as a bell," and the joiner's work and furniture equal to the best ever seen afloat or on shore. Not a single strain, crack, or flaw of any kind has been discovered from stem to stern, in spite of the gale in the Bay.

MESSRS. YARROW & Co., of Poplar, are about to supply the Navy with the first of a number of second-class torpedo-boats, which, though resembling in their hull and general appearance the class built by Messrs. Thornycroft, comprise various novelties. The engines are provided with steam by new tubulous boilers, vertically disposed, which will enable the craft to move by their own machinery almost immediately after the fires are lighted; and they are, besides, fitted with an arrangement for firing two Whiteheads from the bow in accordance with an original plan of the makers, and which has been so thoroughly approved by the Admiralty that their Lordships have ordered it to be adopted in the boats which are supplied by other contractors.

SHIPBUILDING IRON IN THE NORTH.—The official returns of the Board of Arbitration for the Northern Manufactured Iron Trade prove that the production of iron for shipbuilding purposes is now at its highest, and that while the proportion of plates to the whole of the sales of manufactured iron by the associated firms was in 1872 only 30 per cent., it now exceeds 62 per cent. The quantity of plates sold by the associated northern firms has risen from 13,800 tons in 1873 to 27,060 tons monthly at the present time, and the recent commencement of the Wear works will add to the output, the largest portion of which is made at the plate mills in the county of Durham.

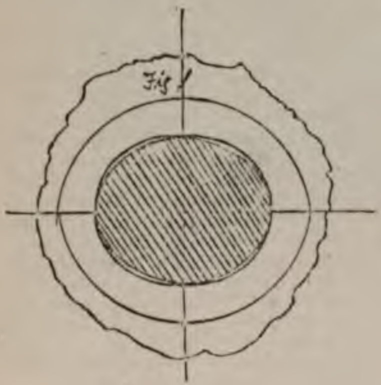
THE German corvette *Möwe*, has a novel improvement in the means of working her anchors. This is the substitution of steel-wire rope a cable for the ordinary chain cable, and the comparative advantages are increase of strength in the proportion of seven to one for cables of the same weight, greater continuity of strength, and greater facility in handling. On Wednesday the apparatus was inspected by Lloyd's surveyor, Mr. Fittock, who was instructed to report to Lloyd's Committee. It was found to answer perfectly in all respects, the vessel at the time riding out a gale with the assistance of the wire-rope cables alone. It is believed that steel-wire cables will ultimately replace chain cables on account of the advantages named above, the difficulty of providing suitable holding apparatus being now overcome.

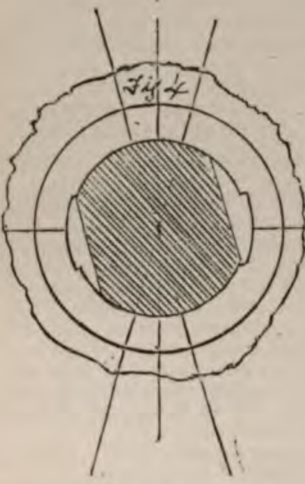
ON THE WEARING OF VIBRATING BEARINGS AND BEARING BRASSES.

By J. Q. Dunstan.

THE nearer the approach to perfection in the details of integral members of a machine the greater will be the machine's efficiency and the higher its modulus; and to no machine can this axiom be with more force applied than to the steam engine, nor to any part of the steam engine more than to its link motion and valve gearing, knowing as we do the importance of this factor in the proper distribution of the steam, and the part that plays in the economy of the whole.

Of course there are other very important details familiar to the expert which, however, in the writer's opinion should only be considered secondarily in reference to the valve gearing.

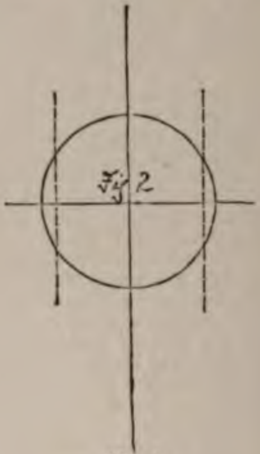


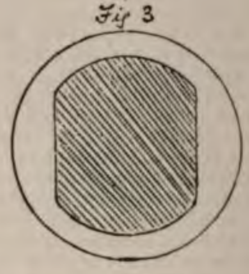


Persons practically acquainted with the working of machinery know that all moving parts evolving friction have a greater or less tendency to wear, which is usually governed by the amount of skill displayed in the design. For revolving surfaces, such for instance as main shaft journals, this wear can readily be taken up and the bearing properly re-adjusted. But with vibratory journals of ordinary construction the case is very different, a fact that seems to have been ignored from the time of Watt to the present day, as far as the writer is aware.

A slight consideration of the facts of the case will show that the wear of most vibrating mechanism is confined to a comparatively small portion of the two opposite surfaces, the extent of it being governed by the amount of vibration in a line with the force and the position of the surfaces will be governed of course by the nature and purpose of the gear. The effect of this peculiarity in the wear is to convert the original circular cross section of bearing and brasses into sections more or less verging on the elliptical, until the journal or bearing assumes a figure approximating to Fig. 1 (the writer has met with examples quite as elliptical as the illustration); and this inherent tendency is assisted by the very endeavour to rectify it, as every time the brasses are let together they must be well cleared at the sides to permit of the major diameter of the ellipse travelling towards the normal position of its minor diameter. This state of things in time, coupled to a little carelessness or too close adjustment, converts a working joint into a rigid lever, and the writer has known serious consequences ensue at sea from this cause that necessitated stopping the ship and wedging or keying-up air-pump lever pins that had been started in the lever in this manner, and having oscillated in the lever instead of the brasses, had worn themselves perfectly slack, thereby indicating their contion by the heavy knock on the pumps occasioned by the slackness.

Doubtless cases of a similar nature have not been infrequent, which would all tend to prove not merely the chaotic state of mechanical disorder inseparable from this faulty design, but that absolutely dangerous and expensive breakdowns and stoppages result from it. When it is remembered what a number of vibrating motions there are in nearly all designs of valve gearing it will readily be conceded how that vital portion of the engine's mechanism may be very gravely affected through these numerous errors, the ultimate proof of which will often be discovered in the coal account; even if the "rattle and clatter" of the gearing be ignored altogether—a very serious inconvenience, by the way, in a passenger ship.





As a solution of the foregoing difficulties the writer submits the following simple plan, which perhaps may not be thought unworthy of some consideration. It consists simply in forming two flat surfaces on the sides of bearing or pin, parallel to each other and to the mean direction of force, the extent of such surfaces depending on the angle of oscillation of the bearing—that is to say, shape away the segments of the circle that are divided by the two dotted chords, see Fig. 2, leaving the bearing or pin in finished section as shown at Fig. 3.

Now such a pin or arbor (or rocking-shaft, or whatever it may happen to be) as represented by Fig. 3 vibrating in ordinary brasses, would make matters rather worse than better, because it would obviously wear shoulders or steps; but, to prevent this, a very slight alteration only is required to the brasses, and consists in taking them from the lathe face-plate, after being bored, to the slotting machine table, and slotting back, say, a sixteenth clearance each side of the half-brass; the angular length of the clearance will, of course, again be governed by the angle of oscillation. The effect of this will be seen at a glance on reference to Fig. 4, which shews centre portions of, say, a pair of link-brasses, and cross-section of pin in position, the alteration being necessarily exaggerated on the figure to render it intelligible to so small a scale.

The effect of wear on such a section as Fig. 3 will be to make it more and more circular, until it assumes a perfectly circular cross section, by which time its safe limit of strength will probably have been reached. Neither will the alteration affect the strength of the vibrating journal, because the slight loss of material is in the direction least likely to be felt; and it cannot in any way increase the tendency of the bearing to heat (on the ground of loss of surface) because the surface taken away is practically of no effect after it has been at work a little while. On the contrary, the writer believes it would greatly assist lubrication, and have a general tendency to prevent heating rather than to cause it.

The plan, at any rate, has this advantage: it may be carried into effect with any existing machinery, if not too greatly worn, or worked into future construction without materially affecting existing designs.

THE SEAHORSE.

A NEW CLASS OF VESSEL.

A VESSEL of an entirely new class was tried yesterday in the Solent. the want had long been recognized in the navy of a quick and powerful ocean tug capable of transporting supernumeraries from place to place at little expense, of acting as a convoy to new ships, and which would also be fitted to act as a tender to a fleet or as a despatch vessel. Part of these duties are somewhat inadequately proformed at the present time by the old paddle steamer *Valorous*, which is slow without being sure, and which is, besides, so thoroughly used up that it may succumb at any moment. When she was removed from the Navy List it was feared there would remain no craft to fulfil the particular service on which she is employed, and recourse would have to be had to vessels much too large and cumbrous for the purpose, and in consequence representing considerable wastefulness in men, material, and fuel consumption, without being efficient. Such being the case, Messrs. Laird, of Birkenhead, designed a vessel which should not only be adapted for Channel transport service and conveying, but which should combine the advantages of a powerful ocean tug, ready at any moment to steam to the assistance of a distressed ironclad. The design was submitted to and accepted by the Admiralty, and the result is the *Seahorse*, built and engined by Messrs. Laird. It may be considered as the first of an entirely new class of vessel. The hull as well as the deck-house with which she is fitted for the accommodation of supernumeraries, are constructed entirely of Siemen's steel, manufactured at the Landore Steel Company's works. The piston rods and some of the other engine forgings are also made of the same material, while the crank shafts are constructed of Whitworth's fluid compressed steel. The dimensions of the *Seahorse* are as follows:—Length, 160 ft.; beam, 26 ft.; depth in hold, 12 ft. 9 in.; and tonnage, 519 tons O.M. She is fitted with two sets of direct-acting inverted compound engines, containing all the latest improvements, each set driving a four-bladed iron propeller. The engines have each one high pressure cylinder 26 in. in diameter, and one low pressure cylinder 45 in. in diameter, with a stroke of 2 ft. 6 in. The total condensing surface is 2,240 square feet. The steam is supplied at 75 lb. pressure from a couple of cylindrical boilers fitted with brass tubes, the heating surface being 3,185 square feet, and the grate surface 127 square feet. The machinery was designed to indicate 1,000 horses, but as will be seen from the *data* obtained at the trial, it developed considerably over the contract power. The *Seahorse* is designed to accommodate, before a crew of 25 men, about 100 supernumeraries, with officers and stores. The coal bunkers are capable of storing 120 tons of coal, which would enable her to steam from 10 to 12 days at an ordinary rate of speed. Should occasion require, however, 60 additional tons can be stowed in the forehold. The ship went out of harbour at 8 o'clock for a six hours' continuous full-power trial of her machinery, advantage being also taken during the day to run her six times on the measured mile in Stokes Bay. She was in the command of Commander Dowding, the contractors being represented by Mr. H. H. Laird and Mr. Bevis, the manager of the firm. The Admiralty were represented by Mr. Bannister, and the Navy and Dockyard by Chief Engineer Williams, R.N., and Mr. Morcom. The draught of the ship was 9 ft. 9in. forward and 11 ft. 11 in. aft, which represents her designed deep load draught, and to bring her down to the necessary immersion 180 tons of dead weight in the shape of coal and iron ballast were required. The mean results of the trial were:—Steam in boilers 73 lb.; vacuum, 26in. starboard and 27in. port; revolutions, 106 starboard and 102 port per minute; mean pressures in cylinders, 33·625 lb. and 11·95 lb. starboard, and 34·91 lb. and 12·59 lb. port; horse-power, 287·89 and 285·34 starboard, and 281·72 and 309·98 port. The total mean indicated horse-power was 1,165·02, while the *maximum* was 1,307·13 horses during the last run: and the mean speed realized was 12·6 knots per hour. Satisfactory, however, as the speed was, the trial was not a mile trial, and when that takes place, considering that the draught of the ship will be less, and the time under way considerably shorter, still better results may be expected. The engines were stopped in 20 sec., started astern in 7 sec., and started from astern to ahead in 14 sec. The coal consumption per hour per unit of power developed was 2·25 lb. Everpthing passed off in the most satisfactory manner, the *Seahorse* proving herself one of the fastest and most handy as well as the most powerful tug in the navy. The Admiralty are desirous of commissioning the *Seahorse* at once, in order that she may bring the *Algerine* from Belfast to complete for sea at Sheerness. The *Algerine* is a gunboat of 800 tons built by Messrs. Harland and Wolff, and has been engined by Messrs. Laird with engines working up to 750-horse power.

CONSTRUCTION OF CARGO STEAMERS.

THE following further memorial from Tyne Shipowners, Shipbuilders and others has been forwarded to the President of the Board of Trade:—

"That to encourage the construction of a safer type of cargo steamer than at present generally employed, your memorialists are of opinion that the Government should revise the system upon which the register tonnage is calculated, and which at present acts as a practical prohibition to the building of the kind of vessel which is considered to be the safest. The type of cargo steamer recently built and building ranges from 2,500 to 3,000 tons burthen, with two decks laid, and a bulwark, which in bad weather must necessarily hold a large volume of water on the upper deck, and tend to endanger the safety of the vessel. A steamer built with the necessary beam to ensure stability and strength so as to allow of an awning deck with railing round the same instead of bulwarks, and with a sufficient freeboard reckoned from the main deck—which freeboard on this type of vesssl is fixed by Lloyd's—would, your memorialists believe, be a much safer ship; but as vessels are built for general trades, the additional space between the main deck and such awning deck would be very rarely used for cargo, whilst it would add considerably to the tonnage, and render it impossible to employ such awning-decked vessel to a profit in competition with those of the ordinary type; in other words, the additional port and other dues consequent on the increased tonnage of an awning deck would place the owners of such vessels at a serious disadvantage. Your memorialists respectfully suggest the desirability or her Majesty's Government considering the question whether the space between the awning and main decks on cargo boats should be computed as tonnage. Your memorialists would respectfully propose that the portion of such cargo space should only pay the tonnage dues for such space when occupied by cargo either wholly or partially, but not otherwise, on the same principle as is now practised in the case of deck cargo when it is carried; or if this proposition does not meet the approval of her Majesty's Government, your memorialists would suggest that a fair and reasonable deduction off the total tonnage of the vessel should be made trom the measurement of such space between the main and awning decks. Your memorialists venture to say that as it is the interest of the Shipowner to build a safe ship, it is equally the duty of the Government to remove every impediment in the way of its accomplishment. Your memorialists express an earnest hope that you will favourably consider this memorial, and take such measures as may give practical effect to the same. And your memorialists will ever pray, &c."

THE Marine Engine Works at Stockton and West Hartlepool are now very busy, consequent on the extensive shipbuilding now in progress. Both at Blair & Co.'s works at Stockton, and at Messrs. Richardson & Son's at Hartlepool, orders are on hand which will keep them fully employed during most of the winter.

A NEW dock has been opened at Port Adelaide. It covers nine acres and has cost £95,000.

ENGINEERING AND SHIPBUILDING.—Although the season is rapidly advancing the shipbuilders continue busy. Last week work was impeded by the bad weather. There are still plenty of orders on hand. In all the big centres of engineering, Middlesbrough, Stockton, the Hartlepools, Sunderland, Gateshead, and Newcastle, there is a great deal of work on hand.

A SERIOUS NUISANCE.

CAPTAINS of steam as well as of sailing vessels will agree with us in branding as a serious nuisance the constantly recurring Roaring noise caused by the escaping steam from tug boats when sent alongside of their vessels for towing purposes.

A steam tug must necessarily keep up a full pressure in her boilers when service is required of her, and when coming alongside of her tow several minutes of stoppage necessarily occurs before the hawsers for towing can be arranged, during which time the pressure in her boilers runs up rapidly, and, as a consequence, her safety valves must at once be lifted to avoid danger. Then most often ensues a scene which does not by any means tend to promote amiable manners in the parties most interested, to wit, the captains of the respective vessels. Indeed, we may say that if strong language is ever likely to be indulged in by either it is in such a time as this, when the Roaring of the escaping steam drowns all attempts to give orders intelligibly, or even to understand them when given.

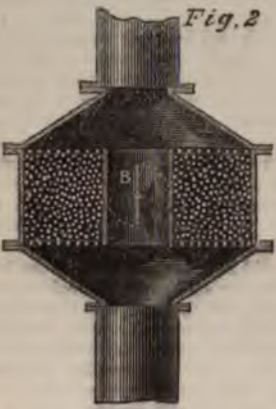
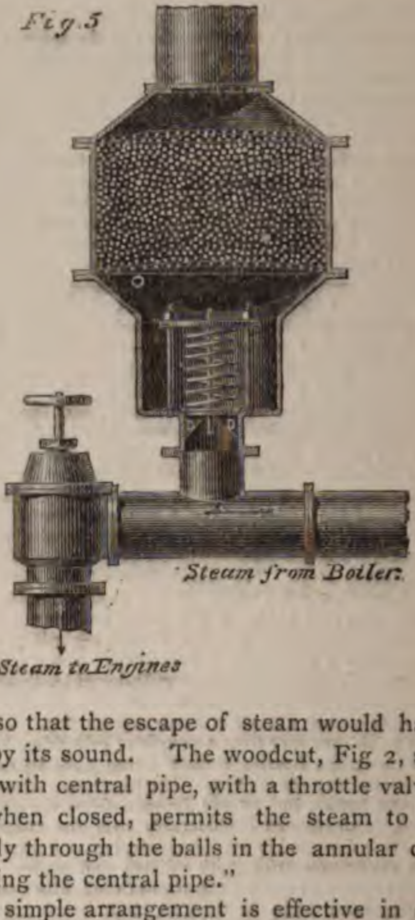


Fig. 2

Therefore we pronounce this uproar an unmistakable nuisance, and we think that every ship's captain and engineer will agree with us in the assertion. Why this nuisance has never been abated we cannot understand, but in the dilemma a new actor appears on the scene, who not only declares this noisy nuisance unnecessary, but who also agrees to suppress it whilst at the same time giving free escape to the steam, and by a means which appears to us to be as simple as it is effective. Mr. Philip S. Justice, of 14, Southampton Buildings, Chancery Lane, London, sends us some illustrations of what he terms his "Steam Quieting" Chambers, which we now give our readers, and which he describes as follows:

"These Chambers may be made of almost any configuration, but cylindrical forms seem most easily adapted. They are of various diameters, according to the areas of the safety valves or steam escape pipes. The heights of the Chambers seldom range more than from 16 to 20 inches. The interior of the "chamber" is filled with small balls of glass, stone, or metal, which are confined between two copper discs, punched with numerous rectangular orifices over their entire surface. The escape steam pipe being attached by a flange to the opening at the bottom of the "chamber," allows the steam to pass through the mass of balls contained in it with entire freedom, and it then escapes by the larger opening at the top of the chamber, and which is connected with the steam funnel; or the chamber may form a part of the base of the funnel as may be desired. When the steam issues from the chamber the roaring noise will have been entirely suppressed, so that the escape of steam would hardly be noticed by its sound. The woodcut, Fig 2, shows a chamber with central pipe, with a throttle valve in it, which, when closed, permits the steam to escape noiselessly through the balls in the annular chamber surrounding the central pipe."

Fig. 5



If this simple arrangement is effective in a steam tug, we can well conceive its great value in ocean going steamers, in cases of collision, and sudden stoppages from any cause, and when a still greater tumult is likely to arrive in times of danger. At such moments an order not heard, or not properly understood, may mean loss of many lives, and a large amount of property, or the vessel itself, and it seems not improbable that, owing mainly to the causes just alluded to, many most calamitous results may be traced.

In passenger steamers Mr. Justice states that he passes the escaping steam, when the engines have been stopped, directly from the main steam supply pipe (see Fig. 5) running to the engines, and not in the slightest manner interfering with the action of the boiler valves; this he arranges by having a separate valve attached to and below his chamber, which will allow of the escape of the steam when desired, and after it is cut off from the engines at a pound or two less pressure than if it escaped by the boiler valves, thus he meets the requirements of the Board of Trade regulations, which are opposed, in passenger steamers, to placing any thing in the free steam way after the steam escapes the boiler valves.

He further states that several years' use of these chambers only convinces him of their sterling usefulness as a means of saving life and property, as well as abating a great nuisance, and as the orders, not only of our own Government but of those of several of the naval powers of Europe, have been repeated to him after due experience, it might be well if our merchant steam service would examine closely into the advantages claimed for "Justice's Quieting Steam Chambers."

THE ENGINEERING EXHIBITION, AGRICULTURAL HALL.

THIS Exhibition, which was held in the Agricultural Hall in the course of the past month, was a very well-intended effort, but failed somewhat in the number of suitable exhibits, owing, we should think, to the want of previous publicity amongst those likely to be exhibitors.

In the class of motors and steam-engines, there were very few exhibits indeed. The Reading Iron Works, and Mr. G. S. Hindley of Bourton, only representing the regular trade; Mr. Stuart, however, of the Bletchley Iron Works, showed an excellent return connecting-rod launch Engine, somewhat after Messrs. Maudsley's patterns. It is one of the lightest and most powerful engines for its size that we have seen. It has two 8-inch cylinders, and measures only 2-ft. 10-in., by 2-ft. 8-in., by 1-ft. 3-in., weighing 6½ cwt., *and developing* 60 *indicating horse power*. This is a startling proportion of work to weight. Mr. Stuart also shows a triple seated safety-valve, which has a special arrangement to ensure all the seats being steam-tight together. Mr. E. E. Wigzell of 37, Walbrook, shows a queer water motor which has a most peculiar and ingenious method of action. It promises to prove very useful for blowing church organs or other domestic machinery. It can, however, be made in any required size, according to the power desired. Messrs. Engleberts show samples of heir Lubricator—described in our August number. Messrs. G. & E. Ransome & Co., and Messrs. Moser & Sons, show a variety of general tools, whilst Messrs. Thomson, Sterne & Co. show a large number of their well-known emery grinding machines. This latter firm shows a case of ship and general fittings in a new metal called "Arguzoid." It is a new alloy in imitation of silver, and is intended to supersede silver plating and nickel-plating. It is superior to brass for all classes of fittings, and has a lustre nearly equal to silver. It does not tarnish quickly, and it is thus easily kept clean and, as it is solid metal, will keep the same colour throughout.

The new metal, or alloy of sulphur, called Spence's metal, attracted a good deal of attention, as it was shown in the attractive form of busts and statues. It seems to be a very valuable material for moulding purposes, and for jointing pipes and flanges.

Captain Barker's marine signalling fog-horn forced itself on the notice of all visitors by its very powerful but clear and sonorous tone. The apparatus consists of an air compressing cylinder, which is then used for the horn-signal by merely opening a valve. The top of the machine consists of a moveable table, on which are marked the points of the compass. When the plate is adjusted to the course the vessel is steering, the horn, gives a corresponding signal. Should such an apparatus be generally adopted, the exact course of a passing vessel could be signalled in a dense fog. The machinery automatically rights itself after each signal. Colonel de la Sala's folding unsinkable boats were also an interesting item in the maritime part of this exhibition. They were shown by Messrs. Meiter & Co. of Gracechurch, who also showed their collapsible signal balls. We were also pleased to see the Watwich Steam Pump in full work, which we gave an illustrated notice in October number—a first-class pump for every purpose, equal to eight single-acting pumps of same diameter and strength of stroke, has but four valves, which are immediately accessible from the outside. The lower chamber contains sufficient water to prime the pump, so that it is always ready to start at any height from its work at which the pump will work. The one exhibited will pump 40 tons of water an hour.

THE armour-plated turret ship *Ajax* was on November 24th placed in the basin at Chatham Dockyard to be completed. The passage round from Pembroke was very rough, the vessel encountering a very heavy gale. Notwithstanding the weather the ship travelled very satisfactorily, her engines working without the least sign of hot bearings. It is considered by those who were on board that the vessel could not have had a much more severe test. The engines, as also those of her sister-ship the *Agamemnon*, were supplied by Messrs. Penn & Son. The *Agamemnon* will be ready for her official trial by about January next, but the *Ajax* will not be ready until about the middle of next year.

THE "DUPLEX" BOILER.

THERE is still much room for improvement in boilers for general marine purposes, and for fast speed launches and torpedo boats. For the maximum work obtainable from the least possible weight of material in engine and boiler, a high initial pressure of steam must necessarily be used, and to do that with safety a multitubular boiler is requisite. Not only should the boiler be multitubular in the ordinary sense, but in the sense that the steam and water should be confined to tubes of small diameter. So much we would say on the score of safety from explosion, and point out that the "Duplex" boiler, with patent tube connectors as made by Patent Steam Boiler Company of London and Birmingham, and illustrated herewith, is specially designed to fulfil these conditions. The steam and water are carried in the horizontal tubes, and there is no large chamber whatever liable to bursting, as the separator also is of small dimensions and of extra strength.

From the point of view, great economy of fuel, there are many points of novelty and improvement worthy of notice. In the first place, the hot gases of combustion are perfectly split up by the large number of tubes and an intervening baffle plate, and strike the comparatively thin heating surface of the tubes at right angles to water current. This is the most efficient for rapid absorption of the heat.

The current of water also descending through the system of tubes from the highest to the lowest, so that as the water passes downwards, it continually meets an increasing temperature in the furnace, and is then finally delivered into the separator. To ensure this downward current of the water, a forced circulation is maintained by a special combined feed and circulation pump which delivers the feed into the top of each coil, and the circulation water of about twice the amount of the feed into a lower portion of each coil.

Although such general arrangements of a forced circulation may be met with in other water-tube boilers, there are some points which, to the best of our knowledge, are quite unique in this boiler. The boiler is divided into two distinct continuous coils with their suitable pipes, separators, and furnaces in duplicate, so that should an accident occur to either part, it can be disconnected; the other portion is still fitted for use. The direction of the water and steam may be seen from the notes on drawing. The feed and the circulation water are admitted at the top as before described from the feed and circulation pump, and thence passing downwards through the coil, is delivered at a tangent as mixed steam and water into the separating vessel. The circulating pump draws the water collecting in the bottom of the separating chamber, whilst the steam passes from the highest point of the separator through super-heating tubes to the engine. The feed-water is drawn from the heating space underneath the furnace, and the steam for the feed-pump is taken from such a point of the separator, that when the water level rises too high, water instead of steam passes to steam cylinder of pump.

Another important arrangement of detail in this boiler is the method of connection between the ends of the tubes, which are made with a special curve to ensure the water standing in each tube when out of work. No filling by hand-pump is thus needful, and sufficient steam may be generated in a few minutes to work the combined-pump as soon as the water is displaced. The boiler is wholly enclosed by an iron casing, which is the best preventative to radiant heat; and as this air is further admitted to the furnaces, even this proportion of heat is utilized.

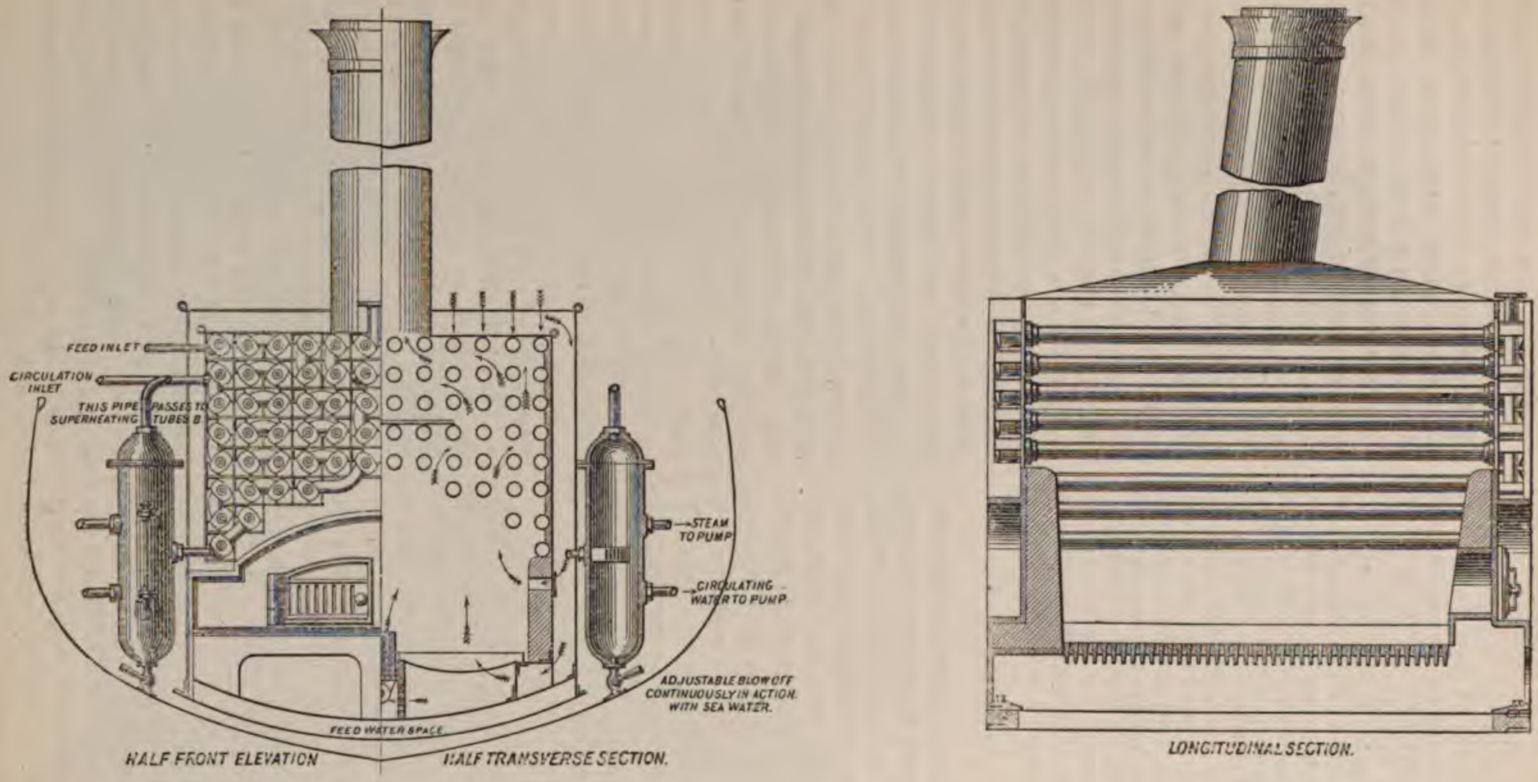
The furnaces are very well arranged for perfect combustion of fuel and smoke. A central ridge of fire-brick is provided through which air can be admitted to furnace, either underneath the bars or over the fuel as required, being adjustable to the greatest nicety by slides.

An automatic damper is provided, which is controlled by the escape of steam from the safety-valve so as to check the draught when necessary. The combined feed and circulating-pump is also specially designed without any dead centre, and thus is not liable to stop at any part of its stroke; and further, if the boiler should become surcharged with water, a portion is ejected, and the speed of the pump is decreased.

As the Patent Steam Boiler Company have already supplied some 34,000-horse power of water tube boilers, they ought to know something about them, and it is much to their credit that no accident to limb, life, or property has ever been caused by their boilers.

* * *

A SERIES of experiments and protracted trials, extending over the past two winters, have been going on at the Royal Arsenal, Woolwich, with the several descriptions of electric lights now before the public with a view to determining whether the new light is applicable to the requirements of the Arsenal workshops. The system which seems, after careful trials, to have found most favour with the Government officials, is that known as the Brush electric light, as supplied by the Anglo-American Electric Light Company. At the present time 16 lamps on this system may nightly be seen in operation, lighting some of the workshops in the Royal Laboratory Department. Much, however, remains to be done in the way of reducing the cost of the light before it can hope to compete successfully with gas. This view of the matter appears to be taken by the chief Government authorities, seeing that extensive additions have just been made to the Government gasworks in the Royal Arsenal. Among the new works, which comprise manufacturing plant, purifiers, steam pumps, &c., is a large gasholder, 150 ft. in diameter, in the construction of which some hundreds of tons of iron have been employed. This new and additional work which has been in progress for the past ten months was completed yesterday, when the new apparatus was taken into use and the large gas-holder filled with gas.


FEED INLET
CIRCULATION INLET
THIS PIPE PASSES TO SUPERHEATING TUBES B
STEAM TO PUMP
CIRCULATING WATER TO PUMP
ADJUSTABLE BLOW OFF CONTINUOUSLY IN ACTION WITH SEA WATER.
FEED WATER SPACE
HALF FRONT ELEVATION
HALF TRANSVERSE SECTION.
LONGITUDINAL SECTION.

THE "DUPLEX" BOILER.

The Patent Steam Boiler Company, Heneage Street, Birmingham, and 117, Palmerston Buildings, London, E.C

THE NORTON SHIP VENTILATOR.

WE have frequently referred to the very unhealthy atmospheres experienced in the huge submarine structures of our ironclads. The atmospheres of many of our best liners are equally unbearable in the engine-rooms and stoke-holes, when passing through tropical latitudes. In addition to all this, an even more important consideration to ship-owners generally, is the foul condition of the atmosphere of holds of cargo vessels carrying fruit and other perishable goods, and lastly the exceedingly dangerous condition of the hold of vessels carrying coal from which the explosion and combustible gases are not expelled by thorough ventilation.

All these evils may be combated by a thorough system of ventilation, and it is only possible to account for the extreme neglect at present evinced for such matters by the supposition that there has been no sufficiently simple apparatus as yet in the market to effect efficient ventilation.

We think that this excuse on the part of ship-owners, or the Admiralty, can no longer be offered, since we have investigated the extremely simple apparatus invented by Captain F. L. Norton, of the United States. The only wonder is that it has never been thought of or applied before, so simple is it in its automatic action on board ships when at sea. The arrangement has been fitted to a sea-going yacht the *Ocean Pearl*, of 300 tons burden, which is now berthed for inspection in the Victoria Docks. The ventilating arrangements consist of a main exhausting trunk or pipe, running from stem to stern, and from which branch out all the smaller pipes to each cabin, stateroom, or hold, from which it is desired to draw the foul air. This main exhaust pipe is connected at the stem to two vertical tubes, 9 ft. long, which are fitted under the stern on each side of the dead wood. The area of each of these pipes is about 90 sq. in., and they are open at the bottom, where they dip for some feet under the water. These verticle pipes terminate at the top above the entrance of the exhaust pipe, as before described, in a discharge pipe which is carried horizontally into the ship for some little distance and then terminates outside it again. This arrangement is adopted to enable the discharge foul air to be made use of on board to blow a fog signal, if desired, as it is in the case of the *Ocean Pearl*. Both the exhaust and discharge entrances into the vertical stern tubes are fitted with valves similar to those of an air pump, the column of water in the lower end of the pipe acting as a piston with the rise and fall of the vessel. As the stern of the vessel rises on a sea the water in the stern tube falls and thus creates a vacuum in the tube above. The valve in the discharge pipe prevents any outside air entering from the atmosphere, and the foul air from the ventilating system is thus forcibly drawn into the stern tubes. On the sinking of the stern the water forcibly rises in the stern tube and thus expels the foul air from the tube into the discharge pipe, and thence into the atmosphere.

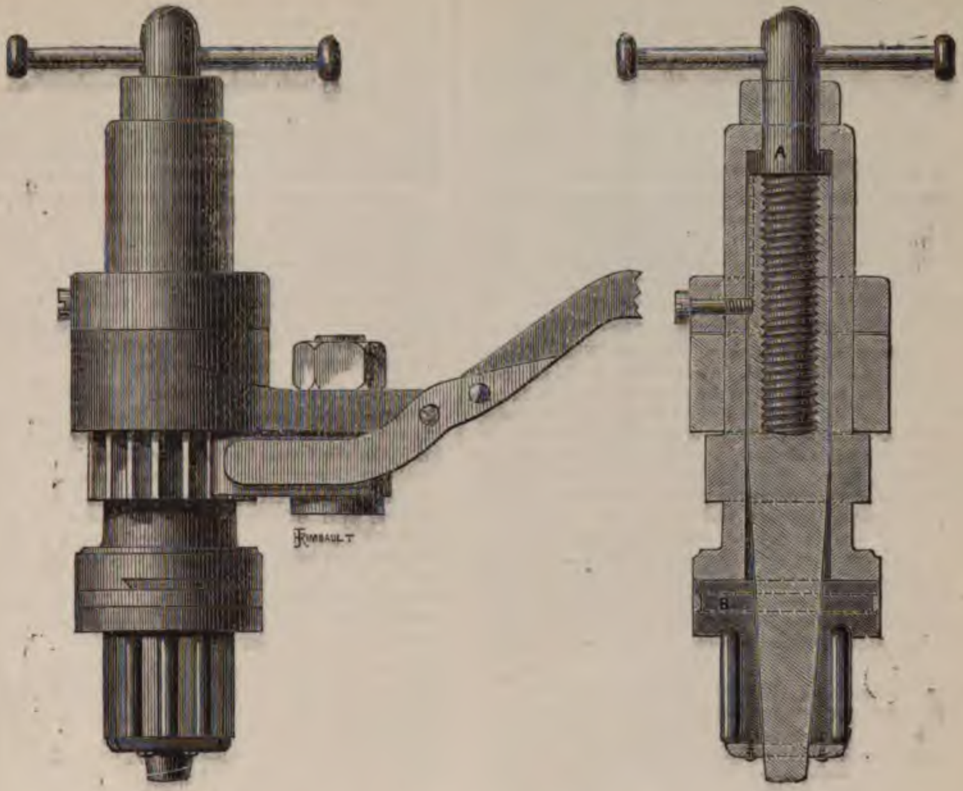
The operation, thus, of ventilation becomes perfectly automatic, when the ship is at sea, and without any moving parts except the two flat valves of the simplest description.

This is exactly what is needed for general ventilation of holds and cabins. When the vessel is in port a simple apparatus in the shape of a water bell is worked up and down in a water chamber by an oscillating lever operated by hand or power. This latter is but a modification of the well-known water exhauster in use at many of our mines, but the automatic arrangement at sea should make this ventilation system invaluable to ship owners, and to our Navy.

COLLAPSIBLE SIGNAL BALL.

IN the new International Steering and Sailing Rules, which we have published in full, and which came into operation on the 1st September, it is incumbent on every ship to carry 3 balls, 2 ft. diameter, for signalling purposes. As such balls are bulky things to stow away, we think that Messrs. Meiter & Co.'s invention of a collapsible ball will prove very convenient for easy stowing away in the smallest possible space. The price also is so moderate that this ball is well worth the attention of ship owners.

A CORRESPONDENT gives particulars of the mishap which befel the ironclad *Achilles*, Captain Kelly during the passage of the Channel Squadron from Plymouth to Queenstown. Early on the Thursday the *Achilles* was observed to fall out of position and to gradually drop out of sight, and it was supposed that something had gone wrong with her machinery. On the following evening however, she again joined company and reported having been in collision with a barque. It appears that about 3 o'clock in the morning the look-out reported a light off the starboard bow. The light was subsequently observed in another direction and the boatswain on the fore bridge answered "All right," but neglected to pass the word to the officer of the watch. The barque was at the time endeavouring to pass between the lines of the squadron, and when the officer of the watch at length became aware of her proximity it was too late to avoid a collision; but by promptly putting the helm a-port, the *Achilles*, instead of striking the merchantman amidships and sinking her, inflicted no more injury than carrying away her steering gear. The skipper sang out to the armourclad to follow, but the barque was out of sight in the fog before the *Achilles* could be put about. Some hours were spent in searching for the barque, but no trace of her could be discovered. The officer of the watch was placed under arrest, and an inquiry was held on board as soon as the *Achilles* arrived at Queenstown.



TULLY'S PATENT TUBE FASTENER.

TULLY'S PATENT TUBE FASTENER.

AS the use of high-pressure multitubular boilers is steadily increasing, any tool or appliance which gives increased convenience or safety in their use, is of great importance. The fixing of such tubes is always a matter of some trouble so as to render them perfectly sound and water-tight, and the tube-fastener that we illustrate, which is the invention of Mr. Tully, of 123, Queen Victoria Street, seems well calculated to effect the steam tight expanding of the tubes. The sectional view shows the construction of this expander. The rollers, which are small and numerous, are carried in expanding pieces B, usually three in number. The taper mandril is forced down gradually by the screw A, thus dispensing with the hammer blows usually employed to drive home the mandril. This, together with the large surface offered by the numerous rollers, should entirely obviate the possibility of splitting the tube during expansion, which is sometimes done with the ordinary expanders. There is also no fear of the tube crumpling or twisting, no matter how great the pressure may be, or of what metal the tubes are composed. The whole apparatus is rotated by the ratchet and handle as shown. The pressure brought on the expanding mandril may be very gradual, by reason of the screw by which it is effected, and the interior of the tube is thus finished very smooth.

As the whole comfort of a voyage to sea-going engineers will frequently depend upon the non-leakage of the tubes, it is evident that it will pay such an engineer to ascertain, and carry the most effective tool for the purpose.

LAUNCHES AND TRIAL TRIPS.

[We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Glendevon.—On November 1st there was launched from Palmer's shipbuilding-yard at Jarrow an iron screw steamship, built to the order of Messrs. Lindsay, Gracie, & Co., Newcastle-on-Tyne, which was named the *Glendevon* by Miss Maude Lindsay, daughter of one of the owners. The *Glendevon* is of the highest class at Lloyd's for hull and machinery. She is fitted with steam winches and Emerson, Walker, & Co.'s patent brass cone brake windlass.

Scotsman.—On November 2nd Messrs. Edward Withy & Co. launched from Middleton Ship-yard, West Hartlepool, an iron screw steamer, which has been built to the order of Messrs. Hugh Black & Co., of Leith. This vessel is No. 91 in the builder's yard, and is the third built for the same owners. Her principal dimensions are: Length between perpendiculars, 260 ft.; beam (extreme), 34 ft.: depth (moulded), 24 ft. She is built as a three-decked cargo boat to Lloyd's highest class, and has topgallant forecastle and long bridge-house, double bottom all fore and aft on the "cellular" principle, main deck of iron throughout, and upper deck of wood, four hatches, and steam winches, steam capstan windlass, and steam steering gear. Engines of 150 nominal horse power will be supplied by Messrs. T. Richardson & Sons, of Hartlepool Iron Works. The vessel is expected to carry 2,500 tons deadweight. As the steamer left the ways she was christened *Scotsman* by Miss Nellie Smith, of Hartlepool.

Banterer and *Espoir.*—The Barrow Shipbuilding Company launched on November 3rd two composite gunboats for Her Majesty's Government. They were named *Banterer* and *Espoir*, and are sister ships to the *Grappler*, *Wrangler*, and *Wasp*, launched from the same yard a few weeks ago. The vessels are 125 ft. long, 23 ft. 6 in. broad, and 12 ft. in depth of hold, the displacement being 455 tons. The engines are 360 indicated horse power. Each vessel will carry four guns—two 64 and two 25 pounders. These gunboats are intended for foreign service.

Pembroke.—On November 4th the Great Western Railway Company's fleet was augmented by the launch from Messrs. Laird's works at Birkenhead of the *Pembroke*, a powerful paddle-wheel steamer, intended to be employed on the Milford and Waterford station. The *Pembroke* has been constructed entirely of Siemen's steel, made at the Landore Works. She is 253 ft. in length, 30 ft. 9 in. in breadth, and 15 ft. deep in hold, and measures 1,182 tons O.M., and will be fitted with a pair of Messrs. Laird's double piston rod vertical oscillating compound engines of the most improved type, having two cylinders, 53 in. and 91 in. diameter, with 7-ft. stroke, supplied with steam at 75 lbs. pressure from two cylindrical boilers. The machinery, which is ready to go on board, is designed to develop about 2,000 indicated horse power, and to propel the vessel at a speed of 15 knots. The passenger accommodation is provided in a full poop entirely shut off from those parts of the vessel where the cattle are stowed. Fittings are provided for 350 head of cattle, special attention having been devoted to the ventilation of the holds and 'tween decks, and the arrangements for the embarkation and landing of the animals. A hurricane deck, extending to within a few feet of the bridge, gives protection from the weather to the second-class passengers, for whom cabins are also provided below. The *Pembroke* was christened by Miss Wynn, daughter of Sir Watkin Wynn, Bart.

Montgomeryshire.—On November 4th Messrs. Raylton Dixon & Co. launched at the Cleveland Dockyard the *Montgomeryshire*, a screw steamer, built to the order of D. J. Jenkins, Esq., M.P., and intended to form one of his line of steamers to China. The *Montgomeryshire* is a vessel of about 2,800 tons deadweight capacity, and is 280 ft. long, 35 ft. 6 in. beam, and 24 ft. 6 in. depth of hold. She will be fitted with passenger accommodation in a full poop. Her engines, of 180-horse power nominal, will be supplied by Messrs. Thomas Richardson & Sons, of Hartlepool, and patent horizontal direct steam combination capstan windlass by Messrs. Emerson, Walker & Co., of London. On leaving the ways she was christened by Miss Bessie May Dixon, daughter of the builder. This is the 14th vessel launched by Messrs. Raylton Dixon & Co. since the commencement of the present year.

Redstart.—On November 4th Messrs. M. Pearse & Co. launched from their iron shipbuilding-yard at Stockton-on-Tees, a screw steamer of the following dimensions: Length between perpendiculars, 222 ft. 6 in.; extreme breadth, 31 ft.; depth of hold to top of floors, 16 ft. 6 in.; with a carrying capacity of about 1,300 tons. She has been built under special survey and is classed 100 A 1 at Lloyd's. The engines are on the compound principle, and have been supplied by Messrs. Blair & Co., of Stockton, and patent horizontal direct steam windlass by Emerson, Walker & Co. She is called the *Redstart*, and is built for London account.

Benedict.—On November 6th Messrs. W. H. Potter & Son launched from their yard, at Queen's Dock, Liverpool, a steamer of about 1,500 tons, built to the order of Mr. Joseph Hoult. As the steamer left the ways Mrs. Robinson, wife of Mr. J. W. Robinson, of Liverpool, performed the ceremony of christening, and gave her the name of *Benedict*. Messrs. John Jones & Sons, of the St. George's Works, will supply her with high-class machinery and boilers. This is the fourth steamer built and engined by the above firm for the same owner this year..

Hartington.—On November 6th Messrs. W. Gray & Co. launched from their yard, at West Hartlepool, another screw steamer, which they have built to the order of Mr. T. S. Hudson, being the third vessel of similar dimensions built by Messrs. Gray for the same gentleman within the past two years, and a fourth is in course of construction. Her dimensions are:—Length, 257 ft. 6 in., breadth, 34 ft. 9 in.; and depth of holds, 19 ft. 6 in. and 24 ft.; gross tonnage, 1,750 tons; classed 100 A 1 (the highest class at Lloyd's), and built under special survey; engines, 150-horse power, by Blair & Co., Stockton, is fitted with Emerson, Walker & Co.'s patent combination windlass. The christening ceremony was performed by Mrs. Hudson, of Seaton Carew. The ship is to be called the *Hartington*.

Romano.—On November 6th the steamer *Romano*, built by Messrs. Earle & Co., of Hull, for Messrs. Thomas Wilson, Sons, & Co., was launched from Messrs. Earle's shipbuilding-yard. The *Romano* is specially designed for the Atlantic trade, and is to trade between Hull and New York. She is 330 ft. long, with 39 ft. length of beam. The measurement from the upper deck to the keel is 30 ft., the depth of the hold being 27 ft. 6 in. She is fitted with a double bottom alike fore and aft, which is divided into four water-tight compartments, the whole being capable of holding 500 tons of water as ballast. Special accommodation has been made for carrying cattle, about 500 head of which can be berthed between the iron stanchions. There are also two decks—the main and upper—both iron, and she has turtle backs fore and aft, accommodation being provided for sailors and firemen underneath the fore one. The bridge is a long one, so as to throw off the water and protect the cattle. The hatches are more numerous than usual, and are more than ordinarily high. The increase over the ordinary number of hatches is with a view to the convenience of loading and unloading with the aid of the steam winches. The bulkheads fore and aft to divide grain space, are iron. The vessel, which is being rigged, is fitted with Cameron's patent steam steering gear, and will be provided with iron masts. The cabins are in the poop in the after part of the vessel. The tonnage is 2,000 tons nett, and about 3,100 tons gross register, and she has a draught of 24 ft. The engines are to be compound surface condensing of 250 horse-power nominal. The cylinders are 32 and 64 inches diameter, with a stroke of 63 in. The engines are of the ordinary double-cylinder type, but have many improvements on any previous engine of this kind. The steam will be produced by three boilers, with a working pressure of 80 lbs. to the square in. The launching ceremony was performed by Mrs. Cameron.

Stamford.—On November 13th a steamer built to the order of Messrs. Thompson & Wrightson, a new firm of Sunderland steamship owners, was launched from the yard of Messrs J. L. Thompson & Son, North Sands, Sunderland. Her principal dimensions are:—Length, 248 ft. over all; breadth, 34 ft.; and 17 ft. depth of hold. Her carrying capacity is estimated at 1,800 tons dead weight. The steamer will be engined by the North-Eastern Marine engineering Company, and will be fitted with the latest improvements. As the vessel left the ways she was named the *Stamford* by Miss Kate Thompson.

Gulf of Panama.—On November 16th an addition to the fleet of the Greenock Steamship Company (Limited), Greenock was made by the launch of the *Gulf of Panama* from the shipbuilding-yard of Messrs. Wigham, Richardson & Co., Low Walker-upon-Tyne. This vessel is fitted with water-ballast throughout the bottom, and will carry 2,500 tons deadweight cargo; has a Napier Brothers' direct steam capstan windlass, a Muir and Caldwell patent steam-steering gear, and will be propelled with compound engines indicating 900 horse-power, of new design, by Mr. Tweedie, the builders' manager. The engines will be supplied with steam from boilers made of steel.

Bowesfield.—On November 16th an iron screw steamer was launched from the building-yard of Messrs. Richardson, Duck & Co., South Stockton-on-Tees, of the following dimensions, viz.:—Length over all, 250 ft. 6 in.; length between perpendiculars, 243 ft.; breadth, extreme, 34 ft. 6 in.; depth in hold, 18 ft. 7 in.; depth moulded, 19 ft. 8½ in.; tonnage, O.M., 1,407 tons; tonnage, gross, N.M., 1,500 tons. She is classed 20 years Liverpool, and has been built under special survey. She has a long quarter-deck extending to the engine room; a bridge over the engines and boiler space, with part of it fitted up for the accommodation of the Captain, officers, and engineers; and a top-gallant forecastle fitted up for the crew. The vessel is supplied with four steam winches for loading and discharging her cargoes, and is fitted with Harfield's patent windlass. Her engines are on the compound direct-acting principle, built by Messrs. Blair & Co. Limited, of Stockton, and are of 150 horse power, with cylinders of 31 in. and 58 in. diameter, the length of stroke being 36 in., with a working pressure of 75 lbs. She is built to the order of Messrs. F. Binnington & Co., of Stockton-on-Tees, and is intended to trade in the Atlantic, Mediterranean, and Baltic ports. As she was leaving the ways she was christened the *Bowesfield* by Mrs. Chapman, of Tower Hall, Middleton-One-Row.

Dorlais.—On November 17th a screw steamer was launched from Messrs. Palmer's yard at Jarrow, to the order of Messrs. Mosel Brothers & Co., Cardiff. This vessel, which is intended for the Bilbao ore trade, is 240 ft. long, 33 ft. broad, and 16 ft. deep. Her carrying capacity is 1,650 tons, and her engines are of 100-horse power moninal. She is named the *Dorlais.*

Cypriana.—On November 17th there was launched from the iron shipbuilding-yard of Messrs. Schlinger & Davis, at Wallsend-on-the-Tyne, a screw steamer, named the *Cypriana*, a sister ship to the *Escombrera*, lying at the same yard. Both vessels have been built for the La Société Francais de steamers, the managing owner of which is Jules Menier, Esq., of Paris and Swansea. The leading dimensions of the *Cypriana* are as follows:—Length 253 ft., breadth 32 ft. 6 in., and depth of hold 19 ft., and she has been built under Lloyd's special survey for the 100 A 1 class. To add to the strength of this vessel, and to lessen the effect of any sea breaking on board, the whole of the houses and companions on deck are built of iron and of circular shape. All the deck fittings are of the best possible kind, and there are four steam winches, Harfield's patent windlass, and her engines are compound surface-condensing, the high pressure cylinder being 30 in. diameter, and the low pressure cylinder 58 in. diameter, each having a stroke of 36 in.

Lufra.—On the 17th November, an iron crew steamer was launched by Messrs. Gray & Co., from their yard at West Hartlepool. The steamer was built to the order of Messrs. Ropner & Co., of the same town, and is the third boat launched for them from the same yard during the present year. Her dimensions are:—Length between the perpendiculars, 256 ft. 6 in.; extreme breadth, 34 ft. 6 in.; depth of holds, 19 ft. 8 in. and 24 ft.; classed 100 A1, the highest class at Lloyd's; engines, 150 horse-power, by Messrs. Blair & Co., Stockton-on-Tees; her gross tonnage is 1,750 tons, and she will carry a dead weight of 2,350 tons. As she left the ways she was christened the *Lufra*, by Mrs. Ropner, wife of the owner.

Yoxford.—On the 17th November, there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay, on Tyne, an iron screw-steamer of the following dimensions, viz:—Length between perpendiculars, 270 ft; breadth, 35 ft; and depth of hold, 24 ft. 6in. to top of floors. She has been built to the order of Messrs. Hunting & Pattison, of Newcastle. The vessel has been built under special survey for the 100 A 1 class Lloyd's, and has been constructed for the general trade. She is to be supplied with steam-steering gear, Harfield's patent windlass, and all other appliances necessary for the convenient and economical working of the vessel. The engines intended for the ship have been made by the North-Eastern Marine Engineering Company, Limited, of Sunderland, and are of 180-horse power nominal. On leaving the ways she was christened the *Yoxford* by Miss Arthur.

Cataluna.—On 18th November, a steamer was launched from the iron shipbuilding yard of Messrs, Hodgson and Soulsby, Cowpen Quay, Blyth. The vessel, which is built to the order of a French firm, is a sister ship to the *Ville de Cette*, recently launched from the same yard, and is of the following dimensions:—Length, 220 ft; breadth, 31 ft; depth of hold, 18½ ft. The steamer is intended for the wine trade between Cette and Spain, and was named the *Cataluna*, by Miss Soulsby, daughter of one of the builders.

Stuart.—On 18th November, Messrs. William Pickersgill & Sons, launched from their yard at Southwick, a handsome screw-steamer to carry 2,000 tons, and of 130 horse-power. Her engines are by Mr. George Clark, of Southwick. The steamer is built to the order of Mr. John Bacon, of Liverpool, for general trades, and is handsomely fitted, and built of the highest class at Lloyd's. She is to be commanded by Captain W. F. Campbell. As she left the ways she was named the *Stuart*, by Mrs. Bacon, the wife of the cwner. She was then taken to the engine works to have her engines and boilers put in. The vessel has been built under the inspection of Mr. Oldham. The sister ships *Brunswick* and *Plantagenet* will shortly follow from the same yard for the same owner.

Cotherstone (s.s).—The *Cotherstone*, screw steamer, was successfully launched from the yard of Messrs. Short Brothers, Sunderland, where she has been built to the order of Mr. J. S. Barwick. Length, 295 ft; breadth, 37 ft; depth, 27½ ft. The vessel is of extra strength, being considerably above the requirements of Liverpool, "Lloyd's" the highest class in which book she will receive. She has a double bottom all fore and aft, has six bulkheads and two complete iron decks, the engines are of 200 horse-power, nominal by Mr. John Dickinson, and the vessel has been built under the superintendence of Mr. Joseph R. Oldham, Consulting Engineer.

LAUNCHES.—SCOTCH.

Keelung.—On the 23rd October Messrs. Scott & Co. launched from their shipbuilding-yard at Cartsdyke, Greenock, a screw steamer of the following dimensions: Length, 250 ft.; breath, 31 ft.; depth, 24 ft. 3in.; and of 1,400 tons burthen. As this steamer left the ways she was named the *Keelung*, and has been built to the order of Messrs. John Swire & Sons, London, making the third steamer (out of the four ordered) recently launched by Messrs. Scott & Co. for the same firm. Like the *Hohihow* and *Pakhoi*, the *Keelung* is intended for the China coasting trade. After the launch the steamer was towed down to the Victoria Harbour, where her boilers and engines will be put on board.

Ponca.—On the 3rd November there was launched from the yard of Messrs. Alexander Hall & Co., Footdee, Aberdeen, an iron screw steamer of 278 ft. in length, 34 ft. 4 in. in breadth, 22 ft. 9 in. depth of hold, and 1,850 tons gross register. She will be rigged as a brig, fitted with compound surface condensing engines of 200-horse power nominal, four steam winches, iron masts, water ballast, and other improvements. The steamer is double-bottomed fore and aft, and has been built to the order of Messrs. Phelps Brothers & Co., of Liverpool, the managers of the Mediterranean and New York Steam Shipping Company, and will be engaged in the New York and Mediterranean grain and fruit trade. She will be commanded by Captain Kempton, late of the *Powhattan*. As the steamer was leaving the ways she was named the *Ponca* by Mrs. Kempton, the wife of the captain.

Katie.—On November 4th Messrs. Alex. Stephen & Sons launched an iron screw steamer of about 2,500 tons, built under special survey to the highest class in Bureau Veritas, and fitted, (before launching) with compound surface-condensing engines having cylinders 38 in. and 68 in. diameter, by 45 in. stroke, and boilers suitable for 85 lbs. pressure. This vessel is intended to be the pioneer of a new line of steamers to run between Stettin and New York, calling at Scandinavian ports, and has been specially designed for this trade. She has flat plate keel and bilge keels, provision for water ballast in double bottom, on bracket principle throughout, steam windlass, steam steering gear, and all modern improvements, and is fitted with accommodation for a few first-class passengers, and a large number of emigrants. The vessel was named *Katie* by Miss Stephen, of Glasgow. The *Katie* was expected to be ready to sail for New York in about a week.

Parisian.—On the 4th November, the steamship *Parisian*, the latest addition to the Allan Line of steamers, was launched from the yard of Messrs. Napier & Sons, Glasgow. The dimensions of the *Parisian* are as follows:—Length of keel, 446 ft; breadth of beam, 46 ft; depth of hold 34 ft. 3 in. The load displacement will be 10,000 tons. She has been designed to meet the requirements of the Canadian trade, among which are great strength of hull and a large deadweight carrying capacity on a moderate draught of water. The steel used has been made by the Steel Company of Scotland, the owners' representative being empowered to make a considerably larger number of tests than is required by Lloyd's rules. The ship is built on the cellular system, with longitudinal and bracket frames, and double bottom right fore and aft. She has three steel decks irrespective of the promenade deck, and forecastle and poop. With a view to rendering her suitable for service as an armed cruiser in time of war, her engine and boiler casings and coal bunkers are made watertight, and no less than ten watertight transverse bulkheads are fitted. The Plimsoll mark is placed at 25 ft. draught, having a freeboard of 11 ft. 3 in. but with ordinary cargoes she will have less draught and a still greater freeboard, thus leaving a large margin of surplus buoyancy. The beam, we may observe, is proportionately greater by about 1 ft. than that adopted by at least one of the most eminent Transatlantic Companies, and this fact, together with the double bottom, watertight subdivision and great freeboard-qualities which conduce to the safety of a vessel, will doubtless render the *Parisian* a favourite with passengers whose time enables them to select their ship. Bilge keels 18 in. deep are fitted for about two-thirds of the length to reduce the rolling. The inside of the bottom plating is protected by a composition of mineral pitch and cement similar to that applied by the Admiralty in war ships, and which has the merit of being over 100 tons lighter in a ship of this size than the mixture of sand and cement generally used in merchant vessels would be. The vessel will be fitted with four masts, square-rigged on the fore and main, and fore and aft sails on the mizen and jigger masts. The first-class passenger accommodation is amidships, steerage passengers and the crew being berthed forward and aft. The cabins are very commodious, two berths only being fitted in each, in addition to a sofa not intended to be used as a berth. The ventilation appears to be particularly well attended to, a principal feature in it being a longitudinal trunk built into the structure of the deck houses and extending over the whole length of the first-class cabins and saloon on each side of the ship, suitable uptake cowls being fitted at intervals to draw air from these trunks. The machinery, also supplied by Messrs. R. Napier & Sons, will consist of compound, three-cylinder engines, the diameter being 60 in. for the high-pressure and 85 in. for the two low-pressure cylinders, stroke 5 feet. The boilers are double-ended, four in number, 18 ft. long by 15 ft. in diameter, having in all 24 furnaces. The propeller is four-bladed, of cast steel, and is 21 ft. in diameter.

Sikh.—On the 6th November there was launched from the shipbuilding-yard of Messrs. Aitken and Mansel, Whiteinch, a screw vessel of about 2,400 tons, built to the order of Messrs. Gellatly, Hankey, Sewell & Co., of London, for their line of steamers trading between London and the East. This vessel is sister ship to the *Afghan*, built by Messrs. Aitken & Mansel for the same owners last year, and was named the *Sikh* by Mrs. Johnstone, wife of captain J. Johnstone. The engines, of 300-h.p. nominal, will be fitted by Messrs. James Howden & Co., Glasgow, and have been constructed under the supervision of the company's superintending engineer, Mr. Malcoln Campbell, London.

Ganges.—On the 17th November there was launched at Dundee, by Messrs. Gourlay, Brothers & Co., a steamer, named the *Ganges*, for Messrs. David Bruce & Co., Dundee and London. Her dimensions are:—Length, 310 ft.; breadth, 36 ft.; depth of hold, 23 ft. 9 in. She will be fitted by her builders with engines of 200 horse-power, and her nett register will be about 1,600 tons. Captain Atkinson, of London, takes command, and she is intended for the North American and Indian trades.

Tamsui.—On the 18th November Messrs. Scott & Co., shipbuilders, launched from their shipbuilding-yard at Cartsdyke, Greenock, a screw steamer of the following dimensions:—Length, 250 ft.; breadth, 31 ft.; depth, 24 ft. 3 in.; and of 1,400 tons burthen. She has been built to the order of Messrs. John Swire & Sons, London, and like the other three steamers recently built by Messrs. Scott & Co. for the same firm, will be engined by the builders—the boilers being fitted with Fox's patent corrugated furnaces by the Leeds Forge Company. As the steamer left the ways she was named the *Tamsui*, and afterwards was taken into the East India Harbour, where her machinery, &c., will be put on board. The launch of this steamer completes the extensive steamship order recently given by Messrs. Swire & Sons to the Messrs. Scott.

Bessie Morris.—On November 19th the *Bessie Morris* was launched at Port Glasgow by Messrs. William Hamilton & Co. The gross register will be about 1,900 tons, deadweight capacity about 2,700 tons, and of cubical measurement about 3,400 tons. After the launch the *Bessie Morris* was towed to Govan, to be engined by Messrs. Dunsmuir & Jackson with very powerful machinery of about 1,000 effective horse-power. The steamer was built to the order of Mr. John Morris, Liverpool, and will be a valuable addition to to the Morris Line of steamers, as she will be finished with all the latest improvements, including steam steering gear, steam stoves for all cabins and berths, &c.

Bancoora.—On the 19th November Messrs. William Denny & Brothers launched from their shipbuilding-yard at Dumbarton a steel screw steamship of the following builders' dimensions:—320 ft. by 40 ft. by 28 ft. 6 in., and about 2,900 tons gross register. She has been built to the order of the British India Steam Navigation Company (Limited), to class 100 A1 at Lloyd's special survey, and has also been surveyed and passed by the Admiralty as suitable for a first-class troop-carrying ship. On leaving the ways the vessel was named the *Bancoora* by Mrs. Templeton, wife of Captain Templeton, the Commander of the *Quetta* (*s*), at present building by the Messrs. Denny for the owners of the *Bancoora*.

Kamtchatka.—On the 20th November Messrs. Lobnitz & Co., launched from their building-yard at Renfrew an iron-screw steamer named the *Kamtchatka*. This vessel is spar-decked, built to Lloyd's highest class, and measures 225 by 29 by 233, and will be fitted with the builders' compound engines of 900 indicated horse power. The builders have constructed this vessel for the Eastern Agency (Limited), London, as agents for Alexander E. Philippeus, Esq., a Russian gentleman engaged in business in Russian ports of the North Pacific. The naming of the ship *Kamtchatka* was accomplished by Mrs. C. H. M. Bosman, of 8, Redcliffe-square, London. The vessel is specially designed for good speed, economy of fuel, and has been fitted with the latest improvements.

Glen Fruin.—On the 20th November, the London and Glasgow Iron Shipbuilding and Engineering Company launched from their yard at Govan an addition to the Glen Line of steamers plying between London and China, India and Japan, managed in London by Messrs. Macgregor & Co., and in Glasgow by Messrs. A. C. Gow & Co. The new steamer, which was named the *Glen Fruin* by Miss Mary Gow, is 360 ft. long, 43 ft, broad, and 26 ft. deep, with a gross tonnage of 3,000. The vessel is fitted up on the double-bottom longitudinal girder system for carrying water ballast, and the builders have adopted all the newest appliances, including Messrs. Muir & Caldwell's steam steering gear, Napier Brothers, steam windlass, steam pumps, &c. Althrough the cargo space is remarkably large and carefully prepared for safety, the accommodation for a limited number of first and second-class passengers has not been neglected. The *Glen Fruin* has been classed 100 A 1 at Lloyd's for a three-deck vessel, and her engines, which are on the compound inverted system, are of 500 nominal horse-power. Since the line started in 1869 the same builders have constructed 10 vessels for them representing an aggregate tonnage of 25,000.

Activ.—On the 20th November, Mr. Robert Chalmers, jun., of Greenock, launched a steamer of 1,000 tons burden for the Baltic trade. The Steamer which is named the *Activ*, is built for Mr. Carl Hassager, of Randers, Denmark, and classed A 1 at Lloyd's under special survey.

Elfrida.—On the 20th November, Messrs. Campbell & Co., Paisley, launched their first steamer. The dimensions are as follows:—165 by 24·6 by 13, classed 100 A 1 at Lloyd's, fitted with water ballast, and having all the latest improvements. She will be fitted with a pair of compound engines of 80 horse-power nominal by Messrs. Fleming & Ferguson, Paisley. This steamer has been built to the order of Messrs. A. C. Colvil & Co., Glasgow, and is intended for the Spanish fruit trade. On leaving the ways she was christened *Elfrida* by Miss Lowden, sister of one of the partners.

Santarem.—On the 23rd November, there was launched from the shipbuilding-yard of Messrs. Blackwood & Gordon, at Port Glasgow, a twin saloon screw steamer of the following dimensions:—180 by 28 by 9·6, 680 tons, B.M. On leaving the ways she was named the *Santarem* by Miss Blackwood, daughter of the builder. The *Santarem* has been built to the order of the Amazon Steam Navigation Company, and will be supplied by her builders with engines of 120 horse-power.

Berwickshire.—On the 24th November, Messrs. Russell & Co., launched from their Greenock yard a barque for Messrs. T. Law & Son, Glasgow, named the *Berwickshire*, and of the following dimensions:—Length, 200 ft; breadth of beam, 32 ft. 6 in; depth of hold, 19 ft. 7 in; of 900 tons register, and will carry 1,480 tons deadweight cargo. This is the sixth vessel built by Messrs. Russell & Co., on the same model, three of them being for Messrs. Law & Son; and the *Berwickshire* makes the fourth barque launched by the same builders for Messrs. Law & Son during the last 15 months.

LAUNCHES.—IRISH.

British Queen.—On the 4th November there was launched from the shipbuilding works of Messrs. Harland & Wolff, at Belfast, a vessel named the *British Queen*, built entirely of steel. Her length is 410 ft., her beam 39 ft., and the tonnage is 3,500 tons gross register.

Algerine.—On the 6th November, this gunboat was successfully launched from the shipbuilding works of Harland & Wolff, Belfast. The *Algerine* is 157 ft. long, her breadth of beam being 29 ft. 6in.

Delcomyn.—On the 20th November, the *Delcomyn* (s), built by Messrs. Wigham Richardson & Co., of the Neptune Works, Newcastle-on-Tyne, had a trial of her machinery. The vessel has been built to the order of Mr. William Lund, of London, and is of the following dimensions:—Length, 287 ft; breadth, 36 ft; depth 25½ ft. Her dead weight capacity is over 2,700 tons. Her engines have also been made by Messrs. Wigham Richardson & Co. The cylinders are 31 and 62 in. diameter, by 48 in. stroke. The boilers are made of steel, and supply steam at 90 lb. pressure. She is fitted with four powerful steam winches, for quickly discharging her cargo, and has water ballast tanks throughout, for emptying which a large Pulsometer is provided. After adjusting compasses, the vessel proceded on her trial run to London, and accomplished the distance from the Tyne to Gravesend in 26 hours, loggings 11¾ knots per hour all the way under steam. The machinery worked with the utmost smoothness, and gave the greatest satisfaction to those on board.

TRIAL TRIPS.

Alene.—On the 29th October the U.S. mail steamer *Alene* 2,050 tons, belonging to the Atlas Steamship Company, of Liverpool, had a successful trial trip. The measured mile was done at a very satisfactory speed, and the owners—Mr. A. B. Forwood & Mr. N. B. Forwood, of Liverpool—expressed themselves highly satisfied at the vessel's performance. This is the fourth vessel built by Messrs. Aitken & Mansel for the Atlas Company. The *Alene* is intended for the company's mail and passenger traffic between New York and Kingston, West Indies. The engines, of 300-horse power, are by Messrs. John & James Thomson, Finnieston Engine Works, and is the sixth vessel they have engined for the Atlas Company.

James Grice.—On the 30th October the *James Grice*, a new steamer of 1,483 tons register, built by James Laing, Esq., Sunderland, for Messrs. Jones Brothers, of Newport (Mon.), went out on her trial trip. After adjusting compasses the steamer was run a given distance to test her speed with the most satisfactory results, an average of 11 knots being maintained with a full cargo on board. The engines, which have been built by the North-Eastern Marine Company, worked very smoothly. After completing her trial she proceeded on her voyage to Constantinople.

Ottawa.—The trial ship of the *Ottawa* (s), built for the Mississippi and Dominion Steamship Company, Limited, by Messrs. Charles Connel & Co., and engined by Messrs. John & James Thomson, Glasgow, took place on the 1st November. Her dimensions are:—375 ft. over all, 40·4 ft. beam, 32·5 ft. depth of hold, 3,712 gross, 2,432 tons nett register, 4,000 tons dead-weight capacity. Has compound engines, cylinders 48-in. and 87-in., stroke 54 in., 500-horse power nominal, 2,200-horse power effective, built under special survey of Lloyd's, and the Board of Trade for passenger requirements; she has extra strength over Lloyd's requirements for the highest class, 100 A 1. The *Ottawa* is fitted with all the improvements for the safe transport of live stock that experience suggests as regards stalls, ventilation, &c. The saloons and state rooms for 24 persons are in a house on deck aft, where no inconvenience can be experienced from cattle. The steerage 'tween decks can accommodate 800 emigrants. Messrs. Bow, M'Lachlan & Co.'s, steam steering-gear is fitted in a wheel-house forward to steer on deck, and also on the bridge; besides, there is the usual double hand steering-gear aft.

Ybarra No. 3.—On the 4th November there proceeded to sea from the shipyard of Messrs. Raylton, Dixon & Co., the *Ybarra No. 3* (s), which, has been built at the Cleveland Dockyard for the well known firm of Messrs. Ybarra Hermanos & Co., of Bilbao, being the second vessel built by Messrs. Raylton, Dixon & Co., for the same owners. Her length over all is 260 ft. by 33 ft. 6 in. beam and 17 ft. depth of hold. She has a long poop extending over the engines and boilers, iron maindeck, double bottom for water ballast throughout. She is specially fitted for the iron trade, in which she will be principally employed, and has three steam winches for rapid loading and discharging of cargo. She will carry over 1,700 tons, and has engines of 140 horse-power nominal, by Messrs. Blair & Co., limited, of Stockton. Her trial trip was in every way most satisfactory, and she will shortly proceed on her first voyage.

Palermo.—On the 4th November this steamer, owned by Messrs. James Hay & Sons, having just undergone extensive repairs and alterations in the hands of Messrs. Henry Murray & Co., proceeded down the Clyde for a trial over the measured mile. She has been fitted with compound surface-condensing engines of 45-horse power nominal, by Messrs. Walker, Henderson & Co., Glasgow, and large steel boilers by the same firm. The average speed attained was fully 10 knots per hour on a consumption of about 4 tons a day, which is considered highly satisfactory.

Bittern (s s).—The steamer *Bittern* which was launched on the 24th September last, had her trial trip on the 4th November. The vessel measures 186 ft. over all, length between the perpendiculars 180 ft. by 28 ft. beam, depth of hold from ceiling to underside of deck, 13 ft. 6 in., schooner rig. Constructed to carry 900 tons on 14 ft. draft of water. Built under special survey to A1 at Lloyd's, by Messrs. H. McIntyre, Paisley, engined by Messrs. Hutson & Corbett, Kilvenhaugh Engine Works, Glasgow, 96 nominal horse-power, indicating 495 horses power. The trial was most satisfactory in every respect, the speed realized being fully 10·5 knots per hour. The *Bittern* is a sister ship to the *Whimbrel*, built for the Cork Steamship Company, Cork, for their Liverpool, Glasgow, and Ghent trade, fitted up with all modern appliances, steam cranes, winches and windlass. Constructed on what is known as the longitudinal system, having a double bottom from the fore peak bulkhead, to the after peak bulkhead, with water ballast tanks in the fore and after holds, and under the engine and boiler spaces each separate. The hull and machinery constructed from the designs and under the superintendence of F. C. Kelson, consulting engineer, Liverpool. At the termination of the trial trip, the *Bittern* returned to Glasgow, took in bunker coals, and left for Whitehaven for a cargo of iron.

Limosa.—On November 6th the iron scwew steamer *Limosa*, of London, just completed by Messrs. M. Pearse & Co., at their shipbuilding-yard at Stockton-on-Tees, had her trial trip before departing on her first voyage. She is 257 ft. in length over all, by 23 ft. depth of hold, and 33½ ft. beam. She is registered at Lloyd's, and has a carrying capacity of 2,500 tons deadweight. Her engines are by the firm of Messrs. Blair & Co. Limited, being 160 horse-power nominal, and are upon the compound surface condensing principle, and fitted with Emerson Walker & Co.'s, patent capstan windlass. After leaving Stockton the steamer proceeded under easy steam into the Tees Bay, where her compasses were adjusted, and all made in readiness for running a trial of speed. After steaming about for some time, with her engines working admirably, the log was hauled in, and found to give a speed of 10½ knots per hour, which was fully satisfactory. At the conclusion of the trip the vessel proceeded on her voyage to Hamburg under the command of Captain Lambert, who has been appointed Master.

Allowrie (s.s).—On the 18th November, the steamer *Allowrie* had a successful trial trip. Starting from the Custom-house Quay at eleven o'clock she proceeded to the measured mile at Skelmorlie. The company on board included Mr. Manning, of the owning firm; Mr. Napier, Mr. Shanks, and Mr. Bell, of the builders' firm; Mr. Blackmore and Mr. Rankin, jun., of the engineering firm; Mr. Chapman, London; Mr. Kenneth M'Caskill, Greenock; Mr. Agnew, Greenock; Mr. Harriot, of the Board of Trade; Mr. Altchin, of Lloyd's; Captain Roddick, master of the *Allowrie*; Mr. Hendry, junr.; Captain M'Kinnon, Greenock; Mr. Blair, Mr. M'Kechnie, cashier; Mr. Dugald Stewart, engineer; &c. It may be stated here that the *Allowrie* (native name of "Wollongong," New South Wales) is a twin screw steamer with an awning deck, built by Messrs. Napier, Shanks, & Bell, of Yoker, in conjunction with Messrs. Rankin & Blackmore, of Greenock, to the order of the Illawarra Steam Navigation Company, of Sydney, through their manager, Mr. Edye Manning, who has superintended the construction of the vessel. She is 180 ft. long, by 24 ft. 6 in. beam, and 16 ft. deep, with a gross tonnage of 515; and is built of Siemen's-Martin steel. The accommodation of the *Allowrie* is all than can be desired for her special trade, and every care has been taken to ensure the utmost comfort of the passengers. The saloon is beautifully fitted up in polished teak and bird-eye maple, relieved by handsome gilt mouldings and ornaments, and the upholstery is of the choicest description; it will accommodate 36 passengers, for whose use white porcelain baths and lavatories have been provided. An elegant apartment has been fitted up for the ladies, and excellent accommodation has been supplied for the steerage passengers. The hull (with the exception of teak being substituted for pitch pine in the awning deck) has been made to the specification of the s.s. *Kameruka*, belonging to the same company, which was constructed by Messrs. Russell & Co., Port-Glasgow, and fitted with four cylinder engines of the ordinary compound type by Messrs. Rankin & Blackmore. The boiler of the *Allowrie* is also made to the same specification, but the engines are on Rankin's patent two cylinder compound principle, this type having been adopted by Mr. Manning, who, after careful inquiry as to their working in the various steamers running so successfully on the Clyde and elsewhere, was thoroughly convinced of their superior power and efficiency in comparison with the four-cylinder or any other type of engines. The engines consist of one high and one low pressure cylinder, 25 and 48 in. in diameter respectively, both having a piston stroke of 27 in. (against two high and two low pressure cylinders, 18 and 36 in. diameter by 24 in. stroke, in the Kameruka). The high pressure cylinder, with its connections is simply a non-condensing engine, and can be worked as such separately, or in conjunction with the low pressure cylinder, which with its surface-condenser and pumps can also be handled independently by means of a reducing valve, which admits the steam at a suitable pressure. Both cylinders are fitted with expansion valves arranged to cut off the steam from one-fourth to seven-eights of the stroke; consequently the utmost economy or the greatest possible power can be obtained as circumstances may require. As illustrating this, we may mention that the twin screw-tug *Conqueror*, belonging to the Clyde Shipping Company, which has a pair of similar engines to the *Allowrie*, left Greenock for London on the 12th October last, with 100 tons of coal on board, and made the passage in 81 hours, although the expansion valves were only admitting steam at less than half stroke. She started from London at 1 p.m. on the 18th October, with the expansion valve full open, having in tow the ship *Ettrickdale*, 1,289 tons register, drawing about 14 ft., being in ballast trim. Notwithstanding a detention of 17 hours by fog at the Nore, and very strong head winds during nearly the whole passage, she reached the Tail-of-the-Bank about 4 a.m. on the 24th, and proceeded to Glasgow with the first tide. On her return to Greenock it was found that there were 18 tons of coal still remaining in the bunkers. She thus completed the round trip on the extremely small consumption of 82 tons, and saved her owners the expense of filling up with coal at London—a feat accomplished for the first time in the towing annals of the Clyde. Steam is supplied to the *Allowrie's* engines by a double-ended steel boiler 12 ft. 1 in. diameter by 16 ft. long, with four furnaces 3 ft. 6 in. diameter; two funnels are fitted, which give the vessel a very smart appearance. The entire machinery has been constructed in accordance with the Board of Trade and Lloyd's rules for a working pressure of 70 lbs. per square inch. The steamer was yesterday taken over the measured mile several times, and it was ascertained that she accomplished the distance in 4 minutes 45 seconds, giving a speed of 12·623 knots, which is over the contracted rate. The results were entirely satisfactory to all concerned.

Ascanius (*s s.*)—This steamer went into the river from the Morpeth Dock Birkenhead for her trial trip on November 11th, and among those on board were Mr. Alfred Holt, owner, and Messrs. A. Crompton, Mr. Rae McKaig, S. W. Wiles, F. B. Salmon, James Meek, Captain Russell, A. E. Garland, Captain Mardon and others. The *Ascanius* then proceeded for a run in the river during which her behaviour was in all respects satisfactory. The machinery worked very smoothly and the boiler (one of Cochrane's patent) supplied abbundance of steam. The manner in which the vessel answered her helm was much appreciated and as she is intended for navigating very tortuous waters this point is of great importance. The *Ascanius* was built and engined by Messrs. Cochrane & Co., of Birkenhead, and intended to sail for Penang the week following.

ERRATUM.—Launches, November Number, *Buckhurst*, a deadweight capacity of 8,300, should be 3,200.

MESSRS. D. L. BENSUSAN & Co., have just supplied two large lamps for the Chiswick Improvement Commissioners to be placed near the Fire Brigade Station under the superintendence of H. O. Smith, Esq., C.E.

THE GLASGOW NAVAL AND MARINE ENGINEERING EXHIBITION.

AN important exhibition, illustrative of the rise, progress, and present position of naval architecture and marine engineering, was opened at Glasgow on November 1st, under the auspices of the Town Council and the local engineers and shipbuilders. The exhibition is held in the Corporation Galleries, where a full dress conversazione took place on the occasion of the opening. Lord Ravensworth, president of the Institution of Naval Architects, assisted at the inaugural ceremony, which was also taken part in by Mr. John Burns, of Castle Wemyss, Mr. J. L. K. Jamieson, late of Messrs. John Elder & Co., and other gentlemen well known in connection with shipping and shipbuilding. The exhibition will remain open until the end of April next year, and no effort has been spared to render it worthy of the great branches of industry it represents. The arrangement of the exhibits has been carried out under the direction of Mr. Paton, Curator of the City Industrial Museum, who has performed his part of the work in a highly atisfactory manner.

The exhibits are classified under five headings—viz., (1) Naval Architecture, (2) Marine Engineering, (3) Equipment, (4) Navigation and Harbour Work, (5) Miscellaneous. That of naval architecture will, doubtless, be the most popular with the visitors to the galleries. It includes models of British and foreign war vessels, sailing ships, paddle and screw steamers, yachts and boats, dredgers and miscellaneous craft, and boats and life-boats. It need hardly be said that these will have much interest for the inhabitants of Glasgow and the other busy towns of the Clyde valley, much of whose prosperity has resulted from the work of its shipbuilders and engineers. The shipbuilding industry of the Clyde, which reached what may be called its zenith of prosperity in 1874, when 309 vessels, with an aggregate tonnage of 277,567, were put into the water, has languished somewhat in recent years; but it is now again enjoying a great wave of prosperity, as may be judged from the fact that in the course of the ten months of the present year now gone 196 vessels have been launched, with a total tonnage of about 186,000. New contracts are being placed almost daily, and these include vessels which show a continual advance both in size and speed upon their predecessors.

Before alluding more particularly to the contents of the exhibition, it may also be noted that very great progress is being made on the Clyde with the construction of vessels with cellular bottoms. Messrs. Denny, of Dumbarton, must be allowed the credit of contributing in an important degree to this important constructive change. When two years ago this firm applied this principle to four sister vessels for the British Steam Navigation Company, they were met with a difficulty in the tonnage measurement of the Board of Trade. The board held that the tonnage of cellular vessels should be computed not to the inner skin, but to a line which embraced the half of the cellular bottom. The Messrs. Denny maintained, on the other hand, that the top of the ballast tank would be just the line of measurement, and this plea they successfully established in the law courts, so that cellular ships have their register tonnage now measured only to the inner skin; and it will be interesting to state that the Messrs. Denny have since built vessels of this class to the number of twelve, giving, with the four already mentioned, a tonnage of 40,000 within about two years. Of course other firms are likewise constructing this class of vessel, and it is computed that there are upwards of 100 steamers built or building on the longitudinal or cellular principle. This, be it noted, has been accomplished in about two years' time, and there is in such a fact ample proof of the enterprise of our shipbuilders, the readiness with which they are prepared—backed by the shipowning class—to adopt all properly certified improvements.

A prominent place in the centre gallery is allotted to a model of the *Comet*, of Henry Bell, the first steam vessel that plied on the Clyde. She was built by John Wood at Port Glasgow, and started in 1812. Her dimensions were 42 ft. long—afterwards increased to 60 ft.—11 ft. broad, and 5 ft. 6 in. deep. She had four paddle wheels, shown in the model, two on either side, but two of them were soon dispensed with. At the time she began to carry passengers her owner boasted that she would steam between Glasgow and Greenock at a rate of five miles an hour. Nor far from the *Comet* are models of the latest of the Clyde river steamers, including the *Lord of the Isles*, and the *Columba*, six times the length of the *Comet*, and steaming at more than four times the speed of the pioneer vessel. Between these two extremes are many fine vessels, some of which are yet doing excellent service, and the whole present at a glance a complete history of the Clyde port lake vessels. In a similar way there are models showing the gradual improvement of sailing vessels and of steamers made of iron, down to the *Arizona*, lately built by Messrs. Elder & Co., which measures 465 ft. in length, with a tonnage of 5,300, and the *Servia*, now in course of construction, which will have a length of 530 ft. The gradual change of proportion in the vessels, constantly becoming more fine and graceful, is well illustrated in the models. There is the same thing observable in the yacht models, the series of which terminate with the *Vanduara*, designed by Mr. Watson, of Glasgow, which carried off so many conspicuous honours during the last yachting season. Some of the models exhibit forms of naval architecture which have been little else than experiments; and the whole gives a vivid idea of the different stages through which the art of shipbuilding has proceeded to its present measure of attainment. The Lords of the Admiralty have lent to the exhibition some four-and-twenty models of vessels of war, including the *Great Harry*, the *Victory*—Nelson's flagship—the *Devastation*, and others, of ancient and modern date; and Messrs. Elder & Co., Napier & Sons, and Palmer, of Newcastle also contribute models of some of the more recent additions to the Navy. It is interesting to contrast these latter with the frigate *Leander*, built in 1810 by Messrs. Scott & Co., of Greenock. The model of the *Great Harry* is likely to call attention in Glasgow to the fact that she was built by Henry VIII. some years after the *Great Michael* of James IV., of Scotland, and, as the Scotch say, to rival if possible that noteworthy vessel. It is a pity that there is no model of the *Great Michael* in existence, for she was really a remarkable ship. She was built at Newhaven, near Edinburgh, and launched in 1511, the date of the *Great Harry's* launch being 1514. The *Great Michael* cost £40,000, an enormous sum in those days. Her dimensions were 240 ft. long by 36 ft. within the walls, and these walls were 10 ft. in thickness, constructed of oak. She carried 300 sailors, 120 gunners, and 1,000 soldiers, and she was commanded by a famous character in Scottish history, Admiral Sir Andrew Wood. The *Great Michael* was sold after the death of James the IV. to the French Government, and it seems to be uncertain what was her ultimate fate.

The Marine Engineering Section contains models of boilers and boiler appliances and governors, all of which are interesting in their way, although they contain no decided novelties. Then in the Equipment Section there are a variety of anchors, boat lowering apparatus, pumps and hydraulic machinery, steering gear, telegraphs, windlasses, and other machines, showing generally the latest inventions and improvements. The Commissioners of Northern Lights have lent a valuable set of models of the more notable lighthouses around the Scottish coasts, with examples of lighting apparatus; and Mr. Deas, the chief engineer of the Clyde Trust, shows a complete set of drawings, models, and sections of the works in connection with the construction of the Queen's Dock. The marine engineering exhibits are very interesting, but they are almost all well-known. The exhibits of the Steel Company of Scotland, and of the Landore Siemens Steel Company (Limited), are likely to attract considerable notice at a time like the present, when improvements in the steel manufacture are receiving so much public attention.

FAST CRUISERS.

IT will be within the recollection of all that the exploits of the *Alabama* during the American war were of the most extraordinary and noteworthy character. The lesson to be derived therefrom is that, whilst the first importance should attach to our armoured ships, it should be seen that their operations may be supplemented in time of war by those of fast unarmoured vessels. In a paper read at the Institution of Naval Architects in 1877, Mr. N. Barnaby, C.B., described the steps which are being taken by the Admiralty to render merchant ships available as armed cruisers for service in time of war, and pointed out the work which such ships could perform either by themselves or acting as auxiliaries to our ironclads. Within the last ten years but few ironclads have been added to the Navy, whilst a considerable number of unarmoured cruisers have been built, so great is the importance rightly or wrongly attached by our naval administrators, to this latter class of vessel which we here propose to notice. In so doing, however, we do not intend to refer to the numerous composite cruisers having speeds varying from 10 to 13 knots, but to those of higher speeds which have been built. In 1869, the *Inconstant*, a ship 337 feet long by 50 feet broad, was added to the Navy, and realized a speed of 16¼ knots, on a displacement of 5,300 tons with 7300 indicated horse-power. About the same time the *Volage* and *Active* were built, realising speeds of 15 knots with 4,300 indicated horse-power, on 3,060 tons displacement, their dimensions being 270 feet long by 42 feet broad. About this time also the American Government projected two fast unarmoured ships, and it was generally understood that the *Inconstant* was designed as a competitor to them, but, unfortunately, the American ships failed to realize the expectations of their designers in the important element of speed. In 1874 the *Raleigh*, 298 feet by 48 feet 6 inches, 4,950 tons displacement, realized 15½ knots with 6,200 indicated horse-power; and in the following year, the *Shah*, 334 feet by 52 feet, 5·900 tons displacement, reached 16¼ knots with 6,900 indicated horse-power. After that we had the *Bacchante* and *Boadicea*, each 280 feet by 45 feet 6 inches, and 4,000 displacement, with a speed of 15 knots and 5,500 indicated horse-power; alo the *Euryalus*, a ship of the same dimensions, but of less power, and 14½ knots speed. All the foregoing ships are built of iron, and are sheathed with wood; and it will be noticed that the *Inconstant*, which was the first (or among the first) built has a knot greater speed than either of the others, and 1½ knot more than most of them. This supremacy, however, was not to be maintained indefinitely, as the introduction of steel, together with the valuable and trustworthy results of the late Mr. Froude's experiments on models, enabled the admiralty to design the *Iris* and *Mercury*, two twin-screw steel vessels of 300 feet by 46 feet, and 3,300 tons displacement. These vessels have been driven at the high speed of 18¾ knots with 7,500 indicated horse-power, and form one of the greatest successes in naval architecture of modern times. In these ships more or less provision has been made to compensate for the absence of armour, by watertight subdivision and by coal protection; still they have to run the risk of being penetrated in a vital part, and sent to the bottom by a single shell.

In view of this the late Goverment caused designs to be prepared for three fast cruisers of similar dimensions and form to the *Iris* and *Mercury*, but with engines of 5,000 indicated horse-power, against 7,500 in the other ships. The weight thus saved in the engines is to be utilized in fitting a steel protective deck 1½ in. thick, extending over the engines, boilers and magazines, and in increasing the space for coal. The armoured deck is to be slightly below the water at the middle line, and curved down so as to be considerably below it at the sides. The present Government approved this design, and have contracted with Messrs. R. Napier & Sons, of Glasgow, to build three ships in accordance with it, to be named the *Leander*, *Phaeton*, and *Arethusa*. The engines—also by Messrs. Napier—are to be twin-screw, horizontal, surface-condensing, with high pressure and all the latest improvements, to develop collectively 5,000 indicated horse-power. With this power a speed of sixteen knots is anticipated, but it is possible that hereafter arrangements may be made for working with a closed stokehole and forced blast, in which case a speed equal to that of the *Iris* and *Mercury* may be obtained.

We make no reference to the vexed question of the armament for these vessels, as many persons of high authority advocate long-range armour-piercing guns, whilst others of equal authority maintain that unarmoured ships of this description must not be pitted against ironclads, but should rather use their greater speed to run away from them. If this view is correct, long-range guns of light character, enabling a considerable number to be carried, are the proper weapons. The *Inconstant* carried armour piercing guns, but later vessels have not been so armed. The *Shah*, for instance, in her action with the Peruvian turret ship *Huascar*, was only able to pierce her opponent's very thin armour in one of the thinnest places, although several shots struck elsewhere. The *Shah's* attack on the *Huascar* was creditable to British pluck, but owing to her being completely unarmoured she ran a terrible risk, and she owes her immunity from serious damage to the fortunate circumstance that the Peruvian gunners sent every shot either short or through her rigging. The armament for the three new cruisers, we believe, has not yet been decided on, but as they are so admirably protected at their vital parts by horizontal armour and coal, and may therefore be considered competent to meet small ironclads on an emergency, it would seem desirable that at least one powerful armour-piercing gun should be carried. The Chilians have armed a merchant ship, now named the *Angamos*, with one of Sir W. Armstrong's new 12-ton long-range guns, and we have no hesitation in saying that, if the *Shah* had been similarly armed, she would have sunk the *Huascar*. The new cruisers will each carry two second-class torpedo-boats, and will, of course, be fitted with torpedo-gear, machine guns and other appliances of modern naval warfare. The rig is to be very light, with square yards on the foremast, and fore and aft sails only on the main and mizen. In these ships will be a considerable step in advance on their predecessors, and the completion of Messrs. Napier's contract will doubtless be watched with considerable interest.—*Iron*.

THE CARE OF STEAM BOILERS.

THE Manchester Steam Users' Association have recently issued to their clients a new sheet of instructions to boiler attendants, the sheet being printed in large type and adapted for hanging in a boiler-house. The contents of the sheet are founded on the "Instructions to Firemen" formerly issued by this Association, but the present instructions are more full than those formerly given. The instructions are very clearly drawn up, and as they deserve to be widely circulated we reprint them in full.

INSTRUCTIONS TO BOILER ATTENDANTS.

Getting up Steam.—Warm the boiler gradually. Do not get up steam from cold water in less than six hours. If possible, light the fires over night.

Nothing turns a new boiler into an old one sooner than getting up steam too quickly. It hogs the furnace tubes, leads to grooving, strains the end plates, and sometimes rips the ring seams of rivets at the bottom of the shell.

Firing.—Fire regularly. After firing, open the ventilating grid in the door for a minute or so. Keep the bars covered right up to the bridge. Keep as thick a fire as the quality of the coal will allow. Do not rouse the fires with a rake. Should the coal cake together, run a slicer in on the top of the bars and gently break up the burning mass.

It has been found by repeated trials that under ordinary fair conditions no smoke need be made with careful hand firing.

Cleaning the Fires and Slacking Ashes.—Clean the fires as often as the clinker renders it necessary. Do not slack the clinkers and ashes on the flooring plates in front of the boiler, but draw them directly into an iron barrow and wheel them away.

Slacking ashes on the flooring plates corrodes the front of the boiler at the flat end-plate, and also at the bottom of the shell where resting on the front cross wall.

Feed-Water Supply.—Set the feed valve so as to give a constant supply, and keep the water up to the height indicated by the water-level pointer.

There is no economy in keeping a great depth of water over the furnace crowns, while the steam space is reduced thereby, and thus the boiler rendered more liable to prime. Nor is there any economy in keeping a very little water over the furnace crowns, while the furnaces are thereby rendered more liable to be laid bare.

Glass Water' Gauges and Floats.—Blow through the test tap at the bottom of the gauge hourly, as well as through the tap in the bottom neck, and the tap in the top neck twice daily. These taps should be blown through more frequently when the water is sedimentary, and whenever the movement of the water in the glass is at all sluggish. Should either of the thoroughfares become choked, clean them out with a wire. Work the floats up and down by hand three or four times a day to see that they are quite free. Always test the glass water gauges and the floats thoroughly the first thing in the morning before firing up.

It does not follow that there is plenty of water in the boiler because there is plenty of water in the gauge glass. The passages may be choked. Also empty gauge glasses are sometimes mistaken for full ones, and explosions have resulted therefrom. Hence the importance of blowing through the test taps frequently.

Blow-Out Taps and Scum Taps.—Open the blow-out-tap in the morning before the engine is started, and at dinner time when the engine is at rest. Open the scum tap when the engine is running, before breakfast, before dinner, and after dinner. If the water be sedimentary, run down half an inch of water at each blowing. If not sedimentary, merely turn the taps round. See that the water is at the height indicated by the water-level pointer at the time of opening the scum tap. Do not neglect blowing out for a single day, even though anti-incrustation compositions are put into boiler.

Water should be blown from the bottom of the boiler when steam is not being drawn off, so that the water may be at rest and the sediment have an opportunity of setting. Water should be blown from the surface when steam is being drawn off, so that the water may be in ebullition and the scum floating on the top. If the water be below the pointer, the scum tap will blow steam: if above the pointer, the scummer will miss the scum.

Safety Valves.—Lift each safety valve by hand in the morning before setting to work, to see that it is free. If there is a low-water safety valve, test it occasionally by lowering the water level to see that the valve begin to blow at the right point. When the boiler is laid off, examine the float and lever and see that they are free, and that they give the valve the full rise.

If safety valves are allowed to go to sleep, they may get set fast.

Shortness of water.—In case the boiler should be found to be short of water, draw the fires if practicable, and draw them quickly, beginning at the front. In some cases it may be more convenient to smother the fires with ashes or with anything else ready at hand. If the fires are not drawn leave the furnace doors open, turn on the feed, lower the dampers, shut down the top valve if the boilers be one of a series and relieve the weight on the safety valve so as to blow off the steam. Warn passers-by from the front of the boiler.

Drawing the fires must be done with discretion, and ought not to be attempted if the furnace crowns have begun to bulge out of shape. At Clay Cross, near Chesterfield, on Thursday, January 14, 1869, as the attendant was in the act of drawing the fire from a furnace overheated from shortness of water, the crown rent, when the torrent of steam and hot water that ensued blew him backwards to a distance of 25 yards, rake in hand, and killed him on the spot.—*See M. S. U. A. Monthly Report for January*, 1869.

Use of Anti-Incrustation Compositions.—Do not use any of these without the consent of the Manchester Steam Users' Association. If used, never introduce them in heavy charges at the manhole or safety-valve, but in small daily quantities along with the feed water.

Many furnace crowns have been overheated and bulged out of shape through the use of anti-incrustation compositions, and in some cases explosions have resulted.—*See M. S. U A. Monthly Reports for June*, 1869, *and April*, 1877.

Emptying the Boiler.—Do not empty the boiler under steam pressure, but cool it down with the water in; then open the blow-out tap and let the water pour out. To quicken the cooling, the damper may be left open, and the steam blown off through the safety valves. Do not on any account dash cold water on to the hot plates. But in cases of emergency, pour cold water in before the hot water is let out, and mix the two together so as to cool the boiler down gradually and generally, and not suddenly and locally.

If a boiler is blown off under steam pressure the plates and brickwork are left hot. The hot plates harden the scale, and the hot brickwork hurts the boiler. Cold water dashed on to hot plates will cause severe straining by local contraction, sometimes sufficient to fracture the seam.

Cleaning out the Boiler.—Clean out the boiler at least every two months, and oftener if the water be sedimentary. Remove all the scale and sediment as well as the flue dust and soot. Show the scale and sediment to the manager. Pass through the flues, and see not only that all the soot and flue dust have been removed, but that the plates have been well brushed. Also see whether the flues are damp or dry, and if damp, find out the cause. Further, see that the thoroughfares in the glass winter gauges and in the blow-out elbow pipe, as well as the thoroughfares and the perforations in the internal feed dispersion pipe and the scum pipe are free. Take the feed pipe and scum troughs out of the boiler if necessary to clean them thoroughly. Take the taps and the feed valves to pieces, examine, clean, and grease them, and if necessary grind them in with a little fine sand. Examine the fusible plugs. Do not put any blocks under the pipes in the hearth pit.

Putting blocks under the pipes in the hearth pit robs them of their spring, strains them, and sometimes breaks them.—*See M. S. U. A. Monthly Report for November*, 1879.

Preparation for Entire Examination.—Have the boiler cooled and carefully cleaned out as explained above. Show both scale and sediment to the inspector, as well as the old cap of the fusible plug, and tell him of any defects that may have manifested themselves in working, and of any repairs or alterations that may have beem made since the last examination.

Unless a boiler be suitably prepared, a satisfactory entire examination cannot be made. Inspectors are sent at considerable expense to make entire examinations, and it is a great disappointment when their visits are wasted from want of preparation. The Association is always happy to afford information to boiler attendants by means of its printed monthly reports, and to help them in the discharge of their duties, and expects them in return to do all they can to promote a thoroughly sound inspection of the boilers under their charge.

Fusible Plugs.—Keep these free from soot on the fire side, and from incrustation on the water side. Change the fusible metal once every year at the time of preparing for the Manchester Steam Users' Association annual entire examination.

If fusible plugs are allowed to become incrusted, or if the metal be worked too long, they become useless, and many furnace crowns have rent from shortness of water, even though fitted with fusible plugs.

General Keeping of Boiler.—Polish up the brass and other bright work in the fittings. Sweep up the flooring plate frequently Keep ashes and water out of the hearth pit below the flooring. plates. Keep the space on the top of the boiler free, and brush it down once or twice a week. Take a pleasure in keeping the boiler and boiler-house clean and bright, and in preventing smoke.

LAVINGTON E. FLETCHER,
Chief Engineer.
Offices of the Manchester Steam Users' Association,
9, Mount-street, Albert-square, Manchester,
1880.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

IMPORTANT NOTICE.

The Editor would be happy to receive from Shipowners, Marine Engineers, and others, accounts as to the best means to prevent pitting in boilers, priming, etc., management of engines at sea, their experiences of breakdowns, repairs, etc., etc., and would willingly find room for them and give the illustrations when drawings can be sent.

To the Editor of the MARINE ENGINEER.

SIR,—Much having been said as to the success of the *Livadia* perhaps some of your readers can inform us as to the value of her *Co-efficient* by *Arcu* of *Midship section* and *Displacement* formulas.

I am, Sir, yours obediently,
VERITAS.

Notes and Novelties.

STEAM LAUNCHES ON THE THAMES.—The trial of Mr. Desvignes for manslaughter at the Central Criminal Court, observes the *Daily News*, ended as might have been expected, in a verdict of not guilty. Mr. Desvignes, however, has but little reason to complain that he was put on his trial on so serious a charge, since it has resulted in clearing up the case against him. The first effect of this calamity and of the trials which have arisen out of it has been to make the owners of steam launches a good deal more careful. But this is only a temporary result ; it followed in the same way after the Reading accident some years ago, and will pass away now as it did then. It is the duty of the Thames Conservancy to take the whole subject in hand at once, and put an end to the reign of terror which really exists on the river. It has been suggested in many quarters that steam launches should be forbidden on the Upper Thames. There are many reasons in favour even of this extreme course. The Thames is a pleasure river. It is almost given up to boating, bathing, angling, and the water companies. Its business traffic is insignficant, and such as there is is not carried on by steamers. The launches represent, therefore, a kind of monopoly of the stream. It is too narrow for them, and the heavy wash they create destroys the banks and fouls the water. Still, the extreme measure of their entire suppression is not likely to be resorted to unless regulation should prove impossible. There must be severe limitation of pace, and there should be a clear rule as to passing. At sea a steamer gives way to a sailing vessel, and there is every reason why this wholesome rule should be enforced as between steam launches and rowing boats on the Thames.

TRADE AT JARROW.—In connection with the great development of trade in iron shipbuilding at Jarrow, it is worthy of notice that a corresponding increase of orders has taken place in the engine department of the Palmer Shipbuilding and Iron Company. So great is the pressure upon the present works that it is found necessary to considerably enlarge the engine works as speedily as possible, and for that purpose notices have been given to all the tenants (workmen) residing in Palmer's-terrace, a row of houses running alongside the south side of the engine works, in order to make room for the enlargement. Owing to the great influx of workmen and others into Jarrow during the past year the workmen under notice to leave these houses have great difficulty in finding new residences. It is stated on high authority that there were never so many houses occupied in Jarrow as at the present time.—*Newcastle Chronicle.*

MESSRS. Blackwood & Gordon, of Port Glasgow, have received orders to build two screws steamers, to be named the *Lizard* and the *Locust* for the conveyance of cattle and rough cargo between Scotland and Ireland.

THE THAMES TRAFFIC.—It is announced that application is intended to be made next Session for leave to bring in a Bill to make better provision for the regulation and control of the traffic on the river Thames, and for erecting works and conveniences on the banks of the river, and in such other places as may be necessary or expedient, for the prevention of accidents and the preservation of lives and property. The Bill contains powers to prevent the use of lights or other things calculated to mislead or interfere with the safe navigation of vessels on the river, and to compel the owners and occupiers of manufactories, mills, and other works near to take such steps as may be necessary for preventing the emission of smoke and noxious vapours from them, and subject offenders to damages, and to provide for the recovery of damages and expenses, particularly in connection with the removal of wrecks and other obstructions. The promoters of the Bill also ask for authority to register and control steam and other craft, of every description, on any part of the river, to limit the number of passengers and the quantity of merchandise on them, to define the powers and duties of those in charge of them ; to control and regulate the speed of steam vessels, &c., and to compel the owners of sailing vessels and barges to employ steam tugs, and, if Parliament should so determine, to prohibit or limit to certain hours the use of steam tugs and launches on any part of the river. The Bill further seeks to repeal, alter, or enlarge the powers and provisions of the several Acts now in force on the Thames with respect to the compulsory employment of pilots, watermen, and lightermen ; to empower the metropolitan and city police to co-operate with the officers of the Conservators to enforce the rules and regulations from time to time in force on the river ; to give metropolitan magistrates and county justices jurisdiction over offences committed on the river ; to repeal or alter any of the provisions of the Merchant Shipping Acts, 1854 to 1876, so far as they apply to the Thames ; to enlarge or alter the powers of the Conservators of the Corporation of the Trinity House, Deptford Strond and of the Waterman's Company, and to repeal, vary, or extinguish certain rights and privileges and to confer others. Powers are also sought respecting bye laws, the levying of tolls, rates, duties, and charges, &c.

SHIP VENTILATION.—Capt. Francis L. Norton, of the United States, has invented a system of ventilation which is said to be applicable wherever artificial ventilation is necessary. The following description of the system is published :—" As applied to ships, the system is automatic so long as the vessel is pitching, even but slightly, being dependent for its action upon the rise and fall of the vessel in the water. Failing this motion, as, for instance, in port or in a calm, the ventilation can be easily effected, either by manual or steam power. In order to demonstrate his invention on shipboard, Captain Norton has had a sailing yacht of 300 tons burden built and ventilated upon his system. This vessel—the *Ocean Pearl*—has recently arrived from America, and is now berthed in the Victoria Docks. The *Ocean Pearl* is 112 feet long, with 26 feet beam, and draws 6 feet of water forward and 10 feet 6 inches aft. The ventilating arrangements consist, in the first place, of a series of small branch tubes laid on to and opening into every cabin and compartment of the ship requiring ventilation. These tubes are all connected with a main exhaust pipe running from stem to stern, at which point it is carried outside the vessel and is connected with a couple of vertical tubes placed one on either side of the stern post. These tubes, which are 9 feet long and have a sectional area of about 90 square inches, are open at the bottom to the water, into which they dip several feet. Connected with these tubes at their top end is also another tube, the discharge pipe, which passes horizontally into the ship for a few feet, nd then terminates outside it again. Both on the exhaust and the discharge pipes is a check valve, which on the one hand prevents any of the foul air drawn from the ship being forced back into it, and on the other prevents any air whatever being drawn through the discharge-pipe. The action of this apparatus is very simple. As the vessel rises the water in the stern tubes falls, and creating a vacuum, causes the vitiated air to be sucked from the ship. As the vessel falls this air is forced out through the discharge tube, the valve on which of course opens, whilst that on the exhaust pipe closes. By fixing a fog-horn on the outlet of the discharge tube the escaping air can be utilised for signalling, as is done on board the *Ocean Pearl*. The process of automatic ventilation is continued so long as the vessel has the slightest vertical motion. When, however, this ceases, as, for instance, in the circumstances indicated, the ventilation can be efficiently maintained by means of an exhausting and forcing device, which can be worked by a boy, and is as effective as the automatic arrangement. This apparatus consists of a water bell or air-chamber, to which a vertical reciprocating motion is imparted by a beam worked by hand, or, if more convenient, by any other means, as for instance, in steamers where engine power will be available."

THROWING OIL ON TROUBLED WATERS.—Experiments calculated to have the most important and benificial results, and which may yet be the means of saving many lives and much valuable property, were made at the entrance of the North Harbour of Peterhead on Monday by Mr. Shields, Wallace Works, Perth, in presence of a number of gentlemen directly interested in seafaring matters. The principle of the invention is that outside a bar an iron pipe be laid along the bottom of the water, at the landward end of which a tank would be situated filled with oil. The oil would pass along the pipe, and, oozing through perforated "roses," rise to the surface, with the effect of preventing the waves breaking, and turning them into long undulating rollers, over which any ship or boat might pass in comparative safety. Mr. Shields, who was accompanied by Mr. Yeaman, ex-M.P., for Dundee; Captain David Gray, of the whaler *Eclipse*; Captain John Gray, of the *Hope*; and ex-Bailie Napier, commenced the experiments shortly after 12 o'clock. The party went on board the steam-tug *Pride of Scotland*, and, before proceeding outside, a bottle of oil was uncorked, was put overboard, and sunk. The oil, as it was forced out by the water, rose to the surface, and the heavy swell which was rolling was smoothed considerably. The tug then steamed out of the North Harbour through a heavy sea, and was stopped on the centre of the bar some distance out. The sea at the time was breaking heavily, and several bottles of oil attached to stones and uncorked were thrown overboard. The effect of the oil on the waves was soon visible both by parties on the pier and the experimentors on board the tug. Instead of the waves breaking, the sea became quite smooth and glassy-looking, and there was a visible softening down of the waves, which in place of being sharp-crested, were turned into long undulating seas. The tug was steamed further out to sea, and further experiments were made with the same satisfactory results; and the opinion was generally expressed that the invention would be the means of enabling vessels to enter dangerous bars with comparative safety. The party returned ashore and watched for some time the part of the sea where the action of the oil upon the waves was still very marked; and it was pointed out that if a few bottles of oil had such an effect upon a rough sea, how much more satisfactory would be the result if a proper apparatus was fitted up at the entrance of a bar.—*Dundee Advertiser.*

Recent applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 19th October to 20th November.

4280 T. Archer, jun. Securing cables and metal hawsers, &c.
4288 J. Windle. Steam generators.
4294 W. R. Lake (communicated by J. A. Whitney). Packing meat and preservation by refrigeration.
4296 H. Simon (communicated by R. Kneeken). Valves and gear.
4298 J. Gibbon. Propelling vessels and propeller.
4317 W. Chance. Feed water heaters.
4331 C. F. Parsons. Revolving shafts.
4373 J. N. Holliday. Steering apparatus.
4377 J. T. Parlour. Facilitating repairs of submerged structures and operations under water.
4379 G. & J. Weir. Detecting and preventing corrosion in steam boilers.
4383 P. W. G. Nunn. Abdominal belts for alleviation of sea sickness.
4384 B. J. B. Mills (communicated by J. F. (Dobson. Self-levelling tables, cattle pens, &c.
4407 J. Humphrys. Steam boilers.
4418 W. Balch. Saving life at sea, &c.
4424 J. & R. Crighton & P. Chell. Valve-gear.
4440 W. Parker & L. Ogden. Regulation of steam supply.
4441 F. King & G. Green. Alarm and indicating apparatus for boilers, &c.
4445 J. B. Ball. Smoke consuming and fuel saving apparatus.
4455 N. Stick. Construction and propulsion of steam and other vessels.
4463 W. Renney. Anti-fouling and preservative composition for ships' bottoms, &c.
4467 J. Russell. Steam boilers.
4481 F. W. Scott. Wire ropes.
4482 E. George & J. B. Morgan. Telephonic cables.
4483 S. Hallam. Valves, &c., steam generators.
4484 J. H. Shoebotham. Collapsing signal-ball.
4488 E. P. Alexander (communicated by C. J. A. Ziegler. Marine engine speed regulator.
4521 R. H. Tweddell. Rivetting ships and other plated structures.
4530 A. Porecky. Steering vessels propelled by paddle wheels.
4542 L. W. Leeds. Steam heating apparatus.
4554 J. W. Shepherd & G. Lines. Ship's ventilators.
4561 F. J. Cheesborough (communicated by F. Jauner.) Furnaces and furnace bars.
4565 T. Cornish. Life rafts, boat protectors, &c.
4567 W. R. Lake (communicated by W. D. Dickey.) Furnaces for combustion of liquid or pulverized fuel.
4593 A. L. Wharton & S. J. Dobson. Fog horns.
4594 D. H. Sisson. Raising and removing sunk or stranded vessels.
4611 R. Hall. Propelling boats, &c.. without oars or steam.
4622. J. Wright. Steam reducing valves.
4629 W. H. Harfield. Ships windlasses.
4630 J. Wright. Anchors.
4636 W. R. Lake (communicated by D. Sinton). Steam boiler and other furnaces.
4649 S. Baxter. Working chain cables and wire ropes.
4650 S. Baxter. Anchors and connecting shackles.
4652 J. Teale. Smoke consumer and fuel economizer.
4656 W. P. Thompson (communicated by J. V. & J. J. Renchar.). Lubricating apparatus.
4662 S. Balli n. Steam boilers.
4674 R. Kendal. Telegraph cables.
4689 J. Waters. Windlasses.
4708 R. & J. Jones. Apparatus for sounding depth of water in ships' wells, &c.
4717 W. F. Lake (communicated by L. Juilliard). Economizing fuel and smoke prevention.
4719 J. H. Johnson (communicated by H. K. Carter and others). Wooden ships or vessels.
4723 J. Howden and W. B. Hill. Steam boilers.
4730 C. Stuart. Safety valves.
4731 C. Stuart. Steam valves and cut off gear.
4747 C. W. Wardle. Governors and speed indicators.
4754 R. Wotherspoon. Steering gear, &c.
4759 J. Proctor. Fuel feed, and actuating fire bars.
4770 P. M. Justice (communicated by J. Barbe). Steam safety valves.
4776 S. Daniels. Obtaining preserving and regulating motive power.
4792 W. L. Wise (communicated by G. Criner). Furnaces for steam boilers.
4800 E. G. Brewer (commuuicated by R. Smith). Propellers, &c.,
4801 J. S. Comrie. Belt for life saving cord.
4831 P. C. Bjerke. Killing and catching whales, &c.,
4839 F. Hime. Propulsion of bodies in air and vessels through water.

⁂ Any information regarding the progress, &c., of these patents will be gladly furnished on application.

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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

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NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible; all are to be had at the present time, but only a limited number.

The Marine Engineer,
LONDON, JANUARY 1, 1881.

EDITORIAL NOTES.

ONE of the most serious questions with regard to the efficiency of our iron-clad navy is, as to how far the vessels are capable of fighting their exceedingly heavy guns with safety to themselves and with likelihood of maintaining a continuous and successful conflict. We are glad to note that, so far, our navy is to be congratulated upon the accession of strength represented by the *Inflexible*, and that, as far as preliminary test can show, the *Inflexible* will be able to exert the full power of her enormous armament with ease and certainty. The tests to which the *Inflexible* was subjected were of the most crucial kind, the charges being gradually raised from 300 lbs. to 400 lbs., and thence to maximum. The guns were also fired at every variety of angle, and both in pairs and in salvoes of all three together. The enormous force of the strains and air disturbance effected by these enormous guns may be better realized from the fact that although no serious and permanent damage was effected by the discharge, still the breastwork deck between the turrets was found to spring an inch-and-a-half downwards, and seven-eighths of an inch upwards, under the effect of the combined charges. A cutter, which was hanging on davits from the bridge, had one of its sides blown in, whilst its companion, resting on crutches, and as near to the point of discharge, was uninjured. It was deduced from this event that boats on crutches are not so liable to damage as when suspended from the davits. We cannot concur in this opinion, as the hanging boat would offer least resistance to atmospheric impact. We think the respective positions of the boats and their angularity to the line of the discharge, would more probably account for the different effect of the discharge upon them. It was found that the most violent concussion was caused when the fire from the two turrets crossed each other, it being in such case sufficient to bend the sliding iron shutters which protected the firing holes. The force of the concussion was most marked within the armoured cross at the front of the flying deck, and was least within the turret itself. A considerable amount of glass and some rivets were broken by the discharges, but they are not of any noticeable importance under such circumstances. A more serious point was the fact that the last discharge did more harm than all the previous discharges or volleys. We hope this does not indicate a deterioration of strength by the former discharges, and that the tests were only just stopped in time to prevent serious and disastrous results.

THE refrigeration of provisions for transhipment either as cargo for sale in England, or simply as provisions in our large passenger liners, becomes daily of more importance. We think the time is not far distant when all Australian and Eastern liners will be fitted throughout with refrigerators, both for the preservation of the stock of food instead of carrying live stock, and also for a supply of ice and cold air to the passengers. The *Orient* which saled from London for Australia early in September, was so fitted, and carried the requisite fresh meat and poultry for 500 passengers, preserved throughout the voyage by refrigerating machinery, which at the same time afforded a constant supply of ice to the passengers' table. The P. & O. steamer *Kaisar-i-Hind* has been fitted with a refrigerating machine, which passes its supply of cold air successively through a meat chamber, a water-cooling chamber, a vegetable compartment, a wine cooler, and a thawing chamber, the air passing from one to the other until it is brought nearly to atmospheric temperature. The largest Tell Coleman refrigerating machine ever made has been just completed for the New South Wales Government with a view to storing the 100 tons of meat which form the average consumption of the *City of Sydney*, and also to facilitate the shipment of from 20 to 30 tons of dead meat daily to Europe.

The armour of the future seems destined to be "compound" in character from the very successful results obtained at Portsmouth from the new steel-faced compound plates as now manufactured by Messrs. Cammell & Co. A compound plate of the type destined for the side armour of the *Conqueror*, 11 inches in thickness, of which the steel face was only 2¾ inches in depth, had already been sucessfully tested in last September, and the present test was merely to ascertain whether any advantage could be obtained by a new method of annealing. The former test had shown satisfactorily that all projectiles were broken up on the face of the plates, and that even at very short ranges there was no penetration. The effect of the shots was merely seen as bulges behind the plate, and the backing was not injured in the least. This last tested plate had been annealed in a furnace heated up to red heat for the space of 6 hours, and then bent and cooled in dry sand. The difference in the results was marked. The cracks which were developed were very fine, not exceeding the character of hair cracks, and the projectiles were broken up in each instance, nor did the penetration exceed 6 to 7 inches.

We see that Messrs. Merryweather & Sons have again been very successful in the construction of a fire engine to be fitted to the Austrian iron-clad *Tegethoff*. A considerable company gathered at the works of the makers to witness the trial, amongst whom were Capt. Linden, the Russian Naval Attaché, his Excellency Chen, the Chinese Ambassador, as well as representatives of the Italian, Peruvian, and Portuguese Governments. Although the pump was only 5¼ inches in diameter by 18 inches stroke, it was found capable of delivering 360 gallons per minute, and could deliver good jets from as many as three nozzles. It is also designed as an auxiliary pump to empty the ship's hold in case of a leak.

Our colonies are by no means backward in pushing on improvements in the means of access to their chief ports and cities, whereby they consider that a shipping trade will be fostered and encouraged. The city of Melbourne has now under consideration a project for deepening the channels of the Yarra and Salt Rivers, which form a circuitous channel of approach of some 3 to 4 miles between the city and Hobson's Bay. When the mother country is sending out such splendid liners as the *Orient*, which can neither approach the city nor even reach the piers of Sandridge on the shores of the Bay, it is time something was done by such a wealthy city as Melbourne, even to the extent of an outlay of £1,163,200, which is the estimated cost by Sir John Coode of the present proposed works. By these improvements the channels of the Yarra and Salt rivers are to be rectified with retaining embankments on either side, the depth of the channel being increased from 13 feet to 22 feet at high tide. It is proposed also to convert a swampy portion or delta of the Yarra river close to the city into docks and quays, with proper facilities for unloading. As the first of the docks is to cover 25 acres, this is evidently no insignificant undertaking, and the amount of the estimate does not seem at all exorbitant.

We have heard it rumoured that the severe shock and injury to the bottom of the *Livadia*, though ascribed to wreckage, is, in competent opinions, due to nothing more than the violent blows of the sea. If this is so, the seaworthiness of the *Livadia* in a rough sea becomes undoubtedly unquestionable. This statement is not so extremely improbable, as we have known cases of steamers in ballast drawing very little water, which have started some of their bottom plates by reason of their pitching in a heavy sea. If, as is possible, the hull of the *Livadia*, when pitching, rises out of the water for a considerable portion of its surface, then we think it quite likely that the heavy shock it would experience in returning to the water would suffice to loosen the plates, and possibly to effect as much damage as that attributed to the wreckage. It must be remembered that the comparative flatness of the under surface of the hull of the *Livadia* would increase the destructive action of any shock, and further that the hull is built of only thin steel plates for river traffic. We should be glad to hear definitely as to the exact character of the damage, and also whether any wreckage was actually seen.

HER MAJESTY'S SHIP "INFLEXIBLE."

THE big turret ship, which has been for so long a time in the hands of the dockyard authorities at Portsmouth, commenced a series of trials, which have been ordered by the Lords of the Admiralty for the purpose of obtaining accurate data upon some matters of crucial importance. Three Woolwich infants which have been got into position, two in the aft turret and the other 80-ton gun in the fore turret, have undergone exhaustive tests at the proof butts in the Government marshes at Woolwich, and the results have in all respects been satisfactory; but then arose the momentous question whether the hull and superstructure of the ship would stand the tremendous shock of the explosion, and whether there was not cause for apprehending serious injury. These, among other points, have to be determined by the series of experiments which commenced on December 16th. The weather was favourable, and the *Inflexible* weighed anchor about 10.30 a.m., having on board Vice-Admiral Sir Houston Stewart, K.C.B., Controller of the Navy; Mr. Barnaby, C.B., Director of Naval Construction Rear-Admiral F. A. Herbert, Director of Naval Ordnance; and Rear-Admiral Boys; and Captain Mayes, Superintendent of Compassess; while Rear-Admiral the Hon. F. A. C. Foley, Superintendent of Portsmouth Dockyard, was in charge of the vessel. Captain Codrington, Superintending the Steam Reserve, directed the navigation, while to Captain Hopkins, of the *Excellent* gunnery ship, was entrusted the carrying out of the gunnery experiments, a specially trained party of gunners from that ship being on board to work the guns. The builder of the ship, Mr. W. B. Robinson, Chief Constructor of Portsmouth Dockyard, with his active lieutenant, Mr. J. C. Froyne, Constructor, who has had the superintendence of the work throughout; Mr. E. Newman, Chief Engineer of the Dockyard, with Mr. Iceley, Inspector of Machinery Afloat, superintended the different departments, the crew and the workmen making up a total strength of something over five hundred.

The departure of the ship was watched with great interest from the shore, an impression prevailing that some unpleasant experiences were in store for those on board, and that the concussion produced by the firing of the heavy ordnance would be far from agreeable. The *Inflexible* was taken some ten or twelve miles off the east end of the Isle of Wight, and shortly after noon a scaling charge of a hundred and thirty pounds was fired from each of the guns. The guns and turrets are worked by hydraulic gear manufactured by the Elswick Ordnance Company, and the colossal weights were manipulated with precision, and without a hitch or misadventure of any kind. The trials are to proceed by stages, and rapid firing is not needed, the authorities desiring, in the first instance, to be thoroughly satisfied as to the capabilities of the ship. Some have thought that the firing of the heavy guns would do serious damage to hull and superstructure, and, perhaps, cripple her splendid machinery, which, by the way, worked very smoothly. When, therefore, the word was passed around that the gun in the fore turret was ready for firing, the upper part of the ship was soon cleared, a few only proceeding to the citadel, from whence the gun was to be fired by electricity. The suspense of the delay in making the first experiment was painful to the people under hatches, who were naturally speculating upon the consequence of the shot. The projectile weighed 1700 lb., and the charge of powder was 300 lb. Would the hull of the ship be affected? Would her hull or superstructure be injured? Would her living freight be in danger? These and other conjectures were soon answered, for the vibration produced by the first shot was not nearly so severe as many had expected. The smashing of glass was trifling, and as to the injury to the hull and superstructure, there was absolutely none.

The next two shots were fired from the after turret, and in the course of the afternoon nine shots, the charges being eventually increased to four hundred pounds, were fired. The experience of succeeding discharges was almost the same as the first, the first seven shots being fired horizontally, and the other two at a slight depression. Some shots were fired on the beam, and some just before it. The simultaneous firing of the three guns may perhaps cause a greater shock, but these experiments tend to show that they can be worked under any conditions without danger to the ship or the crew. No casualty of any kind occurred during the day, and at 6 p.m. the *Inflexible* returned to her anchorage at Spithead.

Notwithstanding the rain and murky atmosphere, which considerably narrowed the horizon, the *Inflexible* left her anchorage again on December 17th, and successfully completed her gunnery trials at sea. The early dusk did not permit of the carrying out of the programme of firing in its entirety, but in curtailing it care was taken to observe the parts which were calculated to subject the endurance of the gun gear and the strength of structures to the most crucial tests. On the previous day the firing was of a progressive and purely tentative character. The rounds were limited to three from each gun. The experiments were confined to independent firing, and though the charges rose from 300 lb. to 400 lb. the *maximum* had not been reached when the trials terminated. On December 17th the firing was exclusively devoted to *maximum* charges, the previous experiments having shown that these could be used without crippling the mechanism or seriously injuring what were presumably the weakest parts of the vessel. The guns were also fired in pairs, and in one instance an electrical salvo was discharged simultaneously from the three guns. The conditions varied from ten degrees of extreme elevation to five degrees of extreme depression, and not only were the guns fired from the beam to starboard and port from both turrets, but the foremost gun was trained to 45 degrees abaft the port beam, 45 degrees before the port beam, and 15 degrees abaft the starboard beam, while the guns in the after turret were trained in one instance 60 degrees before the starboard beam and fired together at 40 degrees before the port beam. As a final and heroic test to try the stability of the deck fittings and superstructure, they were also discharged singly, 75 degrees before and 70 degrees abaft the starboard beam. This brought the projectiles perilously near the centre line of the ship. It was intended to train the fore gun to 15 degrees abaft the starboard beam and to fire the after beam 30 degrees before the port beam, but as these angles would have caused the projectiles almost to graze the main ventilating trunk between the turrets, and would no doubt have carried it away, the training was changed to 15 degrees. When the three guns were fired simultaneously abaft the starboard beam, the concussion was great, but was not found to entail any very untoward results either to the hydraulic gun gear or to the ship. The breastwork deck within the citadel and between the turrets was found to spring from the combined concussions of the salve an inch and a half downwards and seven-eights of an inch upwards from its normal position, the vibration causing one of the cast-iron brackets for carrying the rammer at the fore-turret to break, but the strain which broke the cast-iron will probably be withstood by the wrought-iron bracket by which it will be replaced. It was somewhat of a surprise to discover that the last round, fired from the right after gun at extreme elevation and 70 degrees abaft the starboard beam, did more harm than all the previous discharges, whether together or separately. No doubt, being the last, it put the finishing touches to the weaknesses which the previous firing had all along been developing. The 30 ft. cutter, which was suspended in davits from the bridge, had one of its sides blown in, while its companion, which reposed on crutches near at hand, passed through the ordeal unaffected by the rush of air. This is highly satisfactory, as it represented the proper inboard position of a boat, when a ship is prepared for firing quarters. Some of the screws in the turret apron were broken, and a couple of bolts in the heel of a pillar supporting the deck over the citadel, which had been started during Thursday's firing, were sheared by the vibrations. A few rivets were fractured in the bridge connecting the forward and after superstructures; the standard compass and the tell-tale to the steering wheel in the superstructure both had their glass faces broken; a sash and frame in the after steerage were smashed, and there were other small breakages which it would be ridiculous to mention in connexion with such a ship as the *Inflexible* and the terrible strains to which she had been subjected. It was noticed as a curious circumstance that when the fire from one turret crossed the line of the other the recoil of the air was so powerful as to injure and render unserviceable the iron sliding shutters which protected the latter's firing holds. Stronger shutters will be necessary. It was also noticed that the fire from the discharge of the guns in the after turret entered the open roof of the fore turret and flashed through its gun ports. The force of the concussion was felt most within the armoured cross at the front of the flying deck, and least within the turrets, the extreme length of the gun carrying the shock well away. Both Admiral Foley and Mr. Barnaby, however, remained within the cross and the conning tower, and though they reported the vibration to be great, it was found not to be unbearable. The electric lamps. having been suspended from the deck by indiarubber bands, instead of being rigidly fixed to it, gave no trouble during the firing, and diffused a pleasant light between decks which contrasted well with the drizzle and fog outside. The carbons, however, were seen to throw off a large quantity of unconsumed material, the sparks from which contributed an element of danger where such vast quantities of powder were being handled.

There can be no question now that the *Inflexible* will be able to exert the full power of her enormous armament without injury to herself, and that she has passed through an exceptional and as many thought a dangerous and doubtful trial with an unexpectedly light catalogue of defects and injuries. Both the Admiralty and the country are to be congratulated upon the results.

The *Inflexible* concluded her present series of tests on December 18th, by a measured-mile trial of her machinery in Stokes Bay, the mean of four runs giving a speed of 14.286 knots per hour. During the runs the steam pressure in the boilers averaged 57.57lbs. per square in.; the revolutions of the engines were 77.43 starboard and 76.50 port per minute; and the mean pressures in the cylinders, starboard high 26·5lb., starboard low 8·575lb., port high, 27lb., port low 8·35lb., giving a total indicated power of 7,860·78 horses. The day was very favourable for a full-speed trial, the force of wind being only 2 and the sea smooth. The speed realized on the original trials, which were, however, made on nine inches less mean draught, was nearly half a knot greater. But it must be stated that on the previous occasion the bottom was quite clean, while at this trial the diver reported the wetted surface to be covered with a thin coating of slime, which would necessarily tend to diminish the speed. The ship at the former trial was fitted with two-bladed screws of coarse pitch, the vibration arising from which was so great that the stern of the vessel was severely strained The trials were made with four-bladed Griffith's propellers, the diameter and the pitch being both considerable reduced. The result showed that the vibration was greatly lessened. The *maximum* power was not developed by the engines, which was hardly to be expected as steam had been up in the boilers for several consecutive days during the gunnery trials. The machinery, which was in charge of Mr. Icely, Chief Inspector of Machinery, gave perfect satisfaction, and it is expected that under similar circumstances as regards boiler tubes and hull, the original speed will be maintained, if not exceeded, by the present screws. The *maximum* temperatures were 83deg. in the engine rooms and 128deg. in the stoke-hole, and were considered satisfactory. The Controller of the Navy, Admiral Sir Houston Stewart, and Mr. Barnaby, the Director of Naval Construction, were present at the trial, and the ship was under the command of Capt. Codrington. After the trial the *Inflexible* steamed into harbour, and will be taken in hand for completion.

SPEED CURVES.

WE publish two sets of speed curves, that represent the relations of power to speed of the screw steamer *Charles-Quint*, and of the screw steamer *Shamrock*, both built on the Clyde by Messrs. A. & J. Inglis, to whom shipbuilders and others are indebted for this and much similar information on the same subject of an exact and therefore invaluable nature.

The *Charles-Quint* was the first of the ten mail steamers contracted for in this country by the Compagnie Générale Transatlantique for their service between Marseilles and Algiers that was completed and tried on the measured mile and six hours' run at sea stipulated for by the terms of the contract.

It will be remembered that these ten steamers were distributed over four different shipbuilding firms, four vessels being given to Messrs. John Elder & Co, two to Messrs. A. & J. Inglis, two to Messrs Caird & Co., making eight on the Clyde, and the remaining two to Messrs. Wigham Richardson & Co., on the Tyne.

The very short time from the signing of the contracts within which all the vessels were to be delivered (7½ months) and the fact of so many firms building sister vessels, excited some feelings of emulation both respecting the time of completion and also the speeds of the ships. The honours in point of time and speed have been a close run between Messrs. Inglis & Elder & Co., the former firm having the first of the fleet launched and completed, viz., the *Charles-Quint*, the speed and power curves of which are annexed.

The speed stipulated for was 14 knots, whereas on trial the *Charles-Quint* obtained a mean speed of 15.11 knots. The dimensions of the vessel are, length between perpendiculars 313 ft. 6 in., breadth 33 ft. 6 in., and moulded depth 25 ft. 6 in. The gross tonnage of the vesssl is about 1850 tons. The draught of water on trial was, forward 13 ft. 1¾ in., aft 16 ft. 6¼ in., mean 14 ft. 10 in., and the displacement 2478 tons. The area of midship section on the trial was 420 square feet, and the augmented surface (including keel) was 15.266 square ft. The mean indicated horse power at 15.11 knots was 2062 over six consecutive runs. The indicated horse power at other speeds can be measured approximately from the curve, and the remaining particulars which are of importance, can also be obtained from the diagram in question.

It will be remembered that soon after the trials of the *Charles-Quint*, the *Moise*, the first of the four contracted for by Messrs. John Elder & Co., was tried, and the fact of her having made only 14.418 knots, or nearly three-fourths of a knot less than the *Charles-Quint*, led to an animated correspondence. Into the merits of that we need not enter, but it is only fair to say that in their latter vessels the results so far as we have been able to learn them, have fully sustained the high reputation of Messrs. John Elder & Co.'s firm. The following results have been furnished for the second of those boats, the *St. Augustin*, viz.: True mean speed 15.336 knots, mean indicated horse power 2243, displacement 2480 tons, mean draught 14 ft. 11½ in., and immersed midship area 422 square feet.

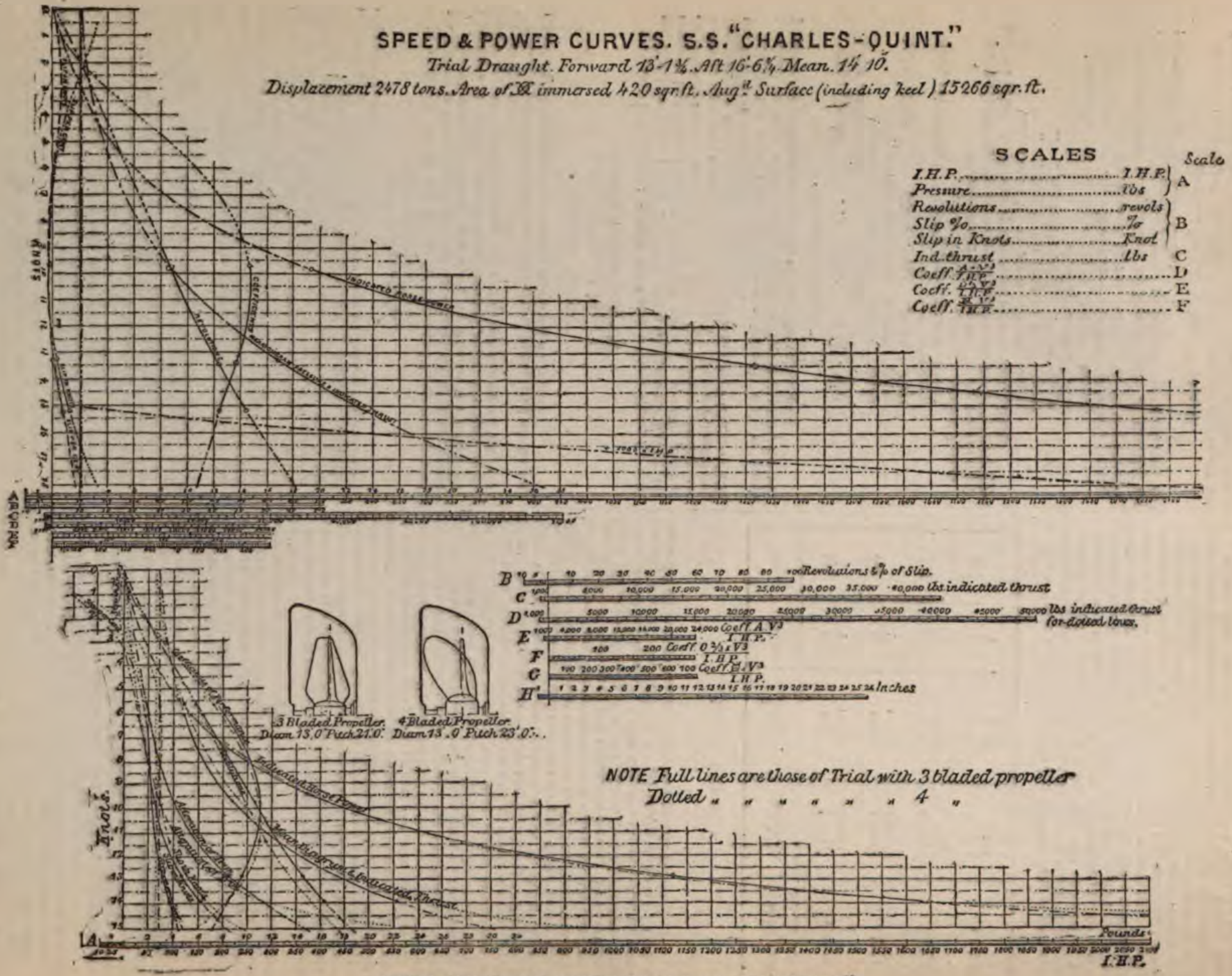
The third vessel launched by Messrs. Elder & Co., as well as the second launched by Messrs. Inglis, have also, it has been stated exceeded the speed of the *Charles-Quint*. Not so, however, with some of the sister vessels built elsewhere, in which there has been a considerable falling off in speed. It is much to be wished, in the interest of screw propulsion, that the great difference, such as is stated to have occurred in these different vessels, all built from the same lines, to fulfil the same conditions, could be thoroughly investigated, as was done when striking anomalies arose in the trials of H.M.S. *Iris*. A great step towards this end would be achieved if all builders would follow in the praiseworthy footsteps of the Admiralty and Messrs. A. & J. Inglis in giving to the profession generally the results of their carefully arranged and conducted experiments.

On the second of the annexed diagrams are shown the curves of speed and power of the *s.s. Shamrock*, a vessel of 832 tons gross register, with registered dimensions of length 231 ft. 2 in., beam 31 ft. 3 in., and depth 15 ft. 5 in., built by Messrs Inglis in 1879. The draught of water of the vessel on trial was 10 ft. 3 in., forward 13 ft. aft and 11 ft. 7½ in. mean. The displacement was 1295.7 tons, and the area of immersed midship section 309.5 square ft., while the augmented surface (including keel) was 10,073 square ft.

These curves show two distinct sets of trials, one with a three-bladed propeller of 13 ft. diameter and 21 ft. pitch, and the other with a four-bladed propeller of 13 ft. diameter, and 23 ft. pitch. These trials show that for very slow speed there is as might be expected but little difference between the efficiency of the two propellers, Between four and ten knots the advantage is on the side of the three-bladed propeller, while from here to about 14 knots, it is on the side of that with four blades, while from there again it would seem to be going in favour of the three-blades. The forms of the two propellers are also indicated on the diagram and add to the interest.

IT may be recollected that a few months ago Messrs. Yarrow & Co., Poplar, built for the Russian Government an improved first-class torpedo boat, the *Batoum*, which steamed safely from this country to the Black Sea. It was 100 ft. long, had a 22-knot speed. and was fitted with a couple of torpodo guns forward, built into the hull, for firing Whitehead torpedoes. We understand that this type of vessel is finding much favour with foreign Governments, owing to their good seagoing qualities, in which respect the old type of torpedo boat was found deficient. In the vessels of the *Batoum* class which Messrs. Yarrow & Co. are now building they have still further improved their power of attack by providing them with three torpedo guns forward instead of two.

FRENCH IRONCLADS.—The following ships of war are being prepared at the present time at the dockyards of France:—The *Kaiman*, building at Toulan; the *Terrible*, building at Brest; the *Indomptable*, building at Lorient; and the *Reguin*, building at Bordeaux, are smaller *Inflexibles*, but with fixed turrets, the guns being mounted *en barbette*. They are each of 7,168 tons displacement, and are protected at the water-line by compound armour 50 centimetres thick at the top and diminishing to 40 centimetres. The *Bayard*, building at Brest; the *Turenne* building at Lorient; and the *Vauban* and the *Duguesclin*, building at Cherbourg, are ships of the *Audacious* class, and are armoured at the water-line by compound plates 25 centimetres in thickness. The *Formidable*, building at Lorient, and the *Admiral Baudin*, building at Brest; are monster-ironclads of 11,300 tons, and armoured at the sides to the extent of from 45 to 55 centimetres. The *Admiral Duperres*, which is being constructed at Marseilles, is a similar vessel, but, while its side armour is of the same thickness, its tonnage is 10,500.



SPEED AND POWER CURVES OF THE S.S. "SHAMROCK."

NOTES ON TRIAL DATA OF SCREW STEAMSHIPS.

By R. Mansel.

THE recently published very extensive and valuable "Results of Trials made on Her Majesty's Screw Ships and Vessels" (to 1st of January, 1880), together with particular cases of trial data of vessels of the merchant navy occasionally published by private parties, will, indeed, be most serviceable in furnishing materials for an investigation of the very difficult, involved, and ill-understood question of screw propulsion. Of the latter class of communications we have an example in the graphically drawn "speed and power" and revolution curves of the s.s. *Charles Quint*, (see page).

I would recall attention to the mathematical statement of the law of these curves in the following slightly varied form: Varying speeds being taken as abscissæ the corresponding ordinates may be taken as representing the product of two factors: first, a *quantity* factor, made up of the product of a constant coefficient and the speed; secondly, an *intensity* factor, a transcendental quantity, which is most simply represented as the number of which the common logarithm is the product of a second constant coefficient and the speed. Thus, for the power curve and the revolution curve respectively, we have:

$$E = b\,V \log.^{-1} a\,V.$$
$$N = n\,V \log.^{-1} m\,V.$$

In which E and N are the gross indicated horse-power and revolutions of the propeller per minute, corresponding to the speed V nautical miles per hour; and b, a, n, and m the respective quantity and intensity coefficients involved in the two equations, which remain constant, so long as the circumstances of the trial remain the same.

The particular values of these coefficients in the trial of the s.s. *Charles Quint* seem to be as in the follow equations:—

"Charles Quint."

$$E = 7.30\,V \log.^{-1} .0842\,V.$$
$$N = 4.01\,V \log.^{-1} .0050\,V.$$

By which it is asserted, within the limits of experience, for any speed V knots, the power is 7,30 V times the number having its common logarithm equal to the value .0842 V; and the number of revolutions per minute 4.01 V times the number having its common logarithm equal to the value .005 V. These calculations, however, are much better performed with the logarithms of the numbers as in the following illustration.

Taking the data from the curves published, with as much accuracy as their small scale permits, in the first place, for the power curve ordinates at the trial speeds, the values are:

"Charles Quint."

Trial speeds ...	15.11	13.42	6.82
These multiplied by .0842 give,			
Values of a V=	1.2722	1.1300	.8269
,, log. V=	1.1793	1.1278	.9912
Value of log. 7.30=	.8631	.8631	.8631
Sum, values log. E=	3.3146	3.1209	2.6812
∴ E=	2063	1321	480 ind. horses.
By curve=	2059	1320	480 very nearly ?

Similarly, the revolution curve ordinates are found by multiplying the same trail speeds by the small number .005, giving.

Values of *m* V =	.0756	.0671	.0492
,, ,, log. V =	1.1793	1.1278	.9912
,, ,, log. 4.01 =	.6030	.6030	.6030
Sum, values of log. N =	1.8579	1.7979	1.6433
∴ N =	72.20	62.80	48.90 rev. per m.
By curve =	72.20	62.00	44.00 very nearly ?

The data, so far as published by Messrs. Elder & Co., for the similar vessel, *St Augustine*, seem to indicate the equation of the power curve for this vessel to be:

$$\text{St. Augustine, } E = 7.47\,V \log.^{-1} .0842\,V.$$

For, at 15.34 knots, the highest trial speed of this vessel, the power is said to have been 2243 indicated horses, corresponding to the above equation; and, hence, its quantity coefficient exceeds that of the *Charles Quint* in the proportion of 7.47 to 7.30, or 2.33 per cent. In other words, the *St. Augustine* under *her* circumstances, for a given speed will take 2.33 per cent. more power than the *Charles Quint* under *her* circumstances, but whether this difference of circumstance means a different screw, weather, draught, trim, or structural variation might possibly be made out by more complete comparative data; and to illustrate the effect of these somewhat capricious elements, it may be instructive to refer to a few examples from the more complete of the trials in the Admiralty Tables referred to in beginning this note.

When curves follow the law indicated in the foregoing statement, they can be treated in a simpler and more direct way by drawing the logarithmic values of their ordinates instead of the natural numbers. For, as is a consequence of the nature of the physical phenomena of which these curves are only the abstract mathematical representation, if we measure these logarithmic ordinates, not from the axis, but from a point at the distance log. V on the opposite side of the axis; then, the upper end of every ordinate willrange in a straight line, which cuts the ordinate through the origin at the distance of the logarithm of the *quantity* coefficient from the axis; and, further, this line is inclined to the axis at the angle which has its natural tangent of the same value as the *intensity* coefficient.

In this way, the variation in position and direction of a straight line is made to give a definite indication of the effect of an alteration in any of the numerous circumstances which influence the trials of a screw steam vessel. Further, in laying down these ordinates from trial data, we have only to consider each of them as diminished by the value of the logarithm of its corresponding speed. The part of the figure below the axis; or, rather, the area bounded by the curve of values of log. V, will be exactly the same in every vessel, and may be left out of consideration; our attention being wholly directed to the straight lines thus defined (named, respectively, the power normal and revolution normal), and to the causes in virtue of which we may find cases of trial data giving aberrations from these normal lines. Thus it is, on writing down the trial values of E and N in a given vessel, if from the logarithms of these we subtract the values of the corresponding log. V, these differences, drawn as ordinates to the natural values of V laid along the axis, define the straight lines of which the two determinate constants are at the same time the two constants which fix the position and magnitude of the power and revolution curves. For example; to draw the power normal of H.M.S. *Shah* (a most excellent illustration, to which I have often referred) from the principal experiments on that vessel, numbered (5) to (8) in the Admiralty Tables, we have the following data, and obvious deductions:

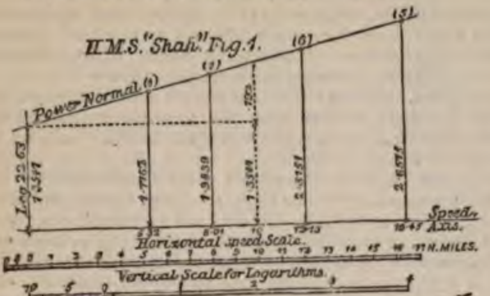
H.M.S. "Shah."

Trial.	Data	Natural Number.	Log. of Number.	Differences.
(5)	E V	7477 16.45	3.8737 1.2161	2.6576
(6)	E V	2506 12.13	3.3990 1.0839	2.3151
(7)	E V	772 8.01	2.8876 .9037	1.9839
(8)	E V	318 5.32	2.5024 .7262	1.7762

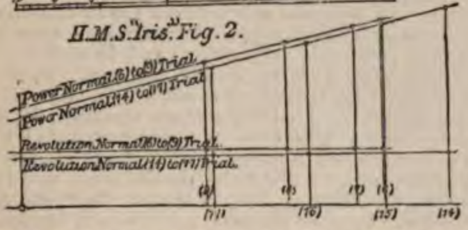
Draw (Fig. 1) the speed axis $o\,x$, and with any convenient scale of natural numbers lay off the trial speeds along that axis, thus 5.32, 8.01, &c. Next, with a scale, the unit of which it will be found better to have several times the length of the unit of the former one, at each speed point draw an ordinate equal to the corresponding difference in the last column of the foregoing Table, and draw the straight line through the upper end. The power normal thus defined will be found to cut the ordinate through the origin at the distance 1.3547 (by the vertical scale from the origin. This is the value of log. b, the number corresponding to which, 22.63, is the value of the *quantity* coefficient of this vessel.

Again, draw the ordinate through the value V=10, and upon this lay off from the axis the value of log. b as found the remainder of this ordinate to the power normal is the value of the *intensity* coefficient a multiplied by ten. In the present instance this, by the vertical scale, measures .792, and hence, $a=.0792$. Consequently, the equation of the power curve of this vessel is

$$\text{H.M.S. Shah, } E=22.63\,V \log^{-1} .0792\,V.$$



H.M.S. "Shah." Fig. 1.


Power Normal (6) to (9) Trial.
Power Normal (14) to (17) Trial.
Revolution Normal (6) to (9) Trial.
Revolution Normal (14) to (17) Trial.
(9)
(8)
(7)
(6)
(17)
(16)
(15)
(14)

H.M.S. "Iris." Fig. 2.

Within the limits of experience, a wide range of from 5.32 to 16.45 nautical miles, the above equation represents the relation between the power and speed with extraordinary fidelity: there is no error whatever at these great extremes of speed; at 12.13 miles it gives 2508 horse instead of the experimental 2506 horse, and at 8.01 miles 781 horse instead of the experimental value 772; certainly an agreement far closer than we have a right to expect. This latter difference of nine horse only represents an error of one twenty-fifth of a knot; so that if, from an unbalanced tidal or wind drift, the speed has been overstated by this small amount, and the observed speed 8.01 knots reduced to 7.97, it might have been said that there was no error whatever on the entire range.

Having thus illustrated one of many modes of procedure by which to determine the normal lines, and involved constants of these and of the corresponding curves, let us now consider two sets of the experimental trials of the twin-screw vessel *Iris*, and from the Admiralty Tables of trials, Nos. (6) to (9) and Nos. (14) to (17); by a like process, it is easy to deduce the equations of the power and revolution curves as follows:

H.M.S. "IRIS."

$$(6)\text{ to }(9)\quad \begin{cases} E_{ii.} = 21.46\,V \log.^{-1} .0707\,V. \\ N_{ii.} = 5.53\,V \log.^{-1} .0006\,V. \end{cases}$$

And, after alterations of the screw, changing into:

H.M.S. "IRIS."

$$(14)\text{ to }(17)\quad \begin{cases} E_{iv.} = 16.30\,V \log.^{-1} .0750\,V. \\ N_{iv.} = 4.28\,V \log.^{-1} .0037\,V. \end{cases}$$

In Fig. 2 is drawn the normal lines corresponding to these curves, and upon which the actual trial values furnished by the Tables are denoted by the centres of the small circles. It will be seen at the highest speeds, in each case, the observation spots fall upon the lines with perfect regularity; at the lowest speeds slight aberrations are sometimes apparent, which are accounted for as residues of tidal and wind drift, not properly neutralised by taking the mean values of an up-and-down run as the mean speed; or, it may be these are due to the beginning of a change in the circumstances of the vessel's flotation and mode of displacing the water, in virtue of which these coefficients pass into very different yet definite values. In the present case it is likelier to be the former cause, which at comparatively low speeds, with even moderate wind and tideway, is quite capable of producing marked aberrations from the normal lines. It is believed the abberration from the power normal of the trial (9) is an illustration of this.*

In the foregoing cases we have the same vessel tried under the same circumstances, draught, and trim, and it is to the specific alterations of her two-bladed twin propellers to which we must look for an explanation of the marked alteration in the position and direction of the normal lines; changes which are equally indicated by the altered values of the constant coefficients of the equations.

The alterations in the propellers are noted in the Admiralty Tables, and are more fully described by Mr. Wright (engineer-in-chief) in his paper read before the Institution of Naval Architects. Briefly stated, by increasing the disc area by one-fourth, and the pitch by about one-sixth, there is a marked diminution in the expenditure of power. The number of revolutions decrease in almost the same ratio, and these changes can be represented generally by taking the ratio of the members of the corresponding questions, thus:

$$\frac{E_{iv.}}{E_{ii.}} = .764 \log.^{-1} .0043\,V, \text{ and } \frac{N_{iv.}}{N_{ii.}} = .7704 \log.^{-1} .0013\,V.$$

Or, to take a particular example, suppose $V = 15$ knots, then we have:

$$E_{iv.} = .8865\,E_{ii.} \text{ and } N_{iv.} = .8630\,N_{ii}:$$

that is to say these changes at 15 knots reduced the expenditure of power by 11½ per cent., and the number of revolutions of the propellor by 13¾ per cent.

More simply still; at any speed, the distance between the normal lines, measured by the vertical scale, is the value of the logarithm of these ratios, and as is obvious with the power normal, the nearer the line is to the axis the greater is the efficiency, and the less the number of revolutions by the revolution normal.

When curves are laid down from trial data according to Mr. W. Denny's graphical method (as given by Messrs. Inglis for the *Charles Quint*) a few trial spots and the induction that the curves must start from the origin, enables the power and revolution curves to be drawn with very approximate accuracy, but there are many cases, where with a considerable number of spots, and an apparently fair curve, we should still fail to recognise many curious variations which do occur, which, certainly are not errors of observation. Even with seemingly fair curves, their general resemblance in character, when complicated with variation in actual magnitude, makes it a very perplexing task to compare them and grasp their points of difference. Only a knowledge of the law of these curves enables this to be done definitely; and the fact that this law involves only two coefficients, makes the attainment of the general comparative relation, or equation of the curve, as it is named, a matter of much simplicity. By the equation of the curve, we calculate values for points when no observation has been made; and, as with very low speeds, where it is impracticable to make them. It may be of some interest to discuss the form of the above curves near the origin as it seems some misconception exists thereanent.

In the first place, the speed being taken in nautical miles, very few values exhaust all practical speeds, whereas the power involves very large numbers, and to prevent the consequent excessive disporportion between the breadth and the height of the curve, the vertical scale is diminished; making it, for example, as in Messrs. Inglis's figures, one-fiftieth of the horizontal; with the effect, however, of making a depressed figure which leaves the origin at less than its true angle; and no observation values near the origin being at all trustworthy, the curve, in this vicinity, is very much a matter of the draughtsman's fancy.

Having obtained the values of the two coefficients a and b from the experiment, subject to the condition of no new change of circumstance having taken place in passing to a new value V, we calculate the value of E by the equation,

$$E=bV \log.^{-1} aV;$$

and further, by a well known principle of co-ordinate geometry, we know, a tangent drawn to any point of this curve, will make with the speed axis and angle θ, such that,

$$\tan.\ \theta=b\,(1+aV) \log.^{-1} aV;$$

and, at the origin where $V=O$, this is reduced to $\tan \theta=b$.

In the case of the *Charles Quint* $b=7.30$, $a=.0842$ and the vertical scale one-fiftieth the horizontal; hence, at the origin, $\tan.\ \theta=.147 \therefore \theta=8$ deg. 22 min., and we may interpolate the following calculated valves between the origin and the first observation point.

Assumed Value. V.	Calculated Value. E.	Drawn in Messrs. Inglis's Figure, very nearly.
1.0	8.8 horses.	17 horses.
3.0	39.1 "	50 "
6.0	140.1 "	150 "
7.5	234.3 "	237 "

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* The necessarily reduced scale at which Mr. Mansel's diagrams have been engraved is too small to show this aberration.

Similarly, for the revolution curve, $n=4.01$, $m_{,}=.005$, and the vertical scale one-tenth the horizontal: hence, at the origin, tan. $\theta=.401 \therefore \theta=21$ deg. 48 min., and by the formula value of the revolutions.

Assumed Value. V.	Calculated Value. N.	Drawn in Messrs. Inglis's Figure, very nearly.
1.0	4.16	5.00
3.0	12.50	13.80
6.0	25.77	27.50
7.5	32.78	34 00

These curves pass through the origin, but there is another closely related curve which does not do so. This is the curve of piston pressures defined as follows: let P and p denote the mean diagram pressure on a square inch of the high and low pressure pistons respectively, and r the ratio of the area of these; so that, at any instant, the sum of the mean pressures upon a pair of cylinders of the diameter d of the high pressure cylinder, is exactly the same as the mean pressures upon the unequal pistons of the compound engine. And, since this is represented by

$$\frac{\pi d^2}{4}(P + rp),$$

in regard to the general value of the variable factor $P + rp)$ from the foregoing equations of the power and revolution curves, it follows, for an assumed value of V, we must have

$$(P + rp)_{,} = f \log.^{-1} (a - m) V.$$

Where f is the value of $(P + rp)$, at which, under the circumstances of trial, the pistons would begin to move. The logarithms of the value of $(P + rp)$ are also ordinates to an inclined straight line named the pressure normal; but in this case they end at the speed axis, and do not as in the case of the ordinates of the power and revolution normals, extend beyond the axis by the value log. V, as is necessary in order to give the full value of the logarithm of the ordinate of the power and revolution curves. The coefficient f of the pressure curve and normal depends upon the values of the coefficients of the power and revolution curves and normals, and may be easily found to be:

$$f = \left(\frac{21010}{d^2 s}\right)\frac{b}{n}$$

Where d and s denote the diameter and stroke of the high-pressure cylinder. In the Charles Quint the value of f by this formula is 5.42; also, since $a=.0842$, and $m=.005$, it follows from the foregoing,

$$(P + rp) = 5.42 \log.^{-1} .0792\ V.$$

Thus, for example,

Trial values of V=	15.11	13.42	9.82 miles
Value .0702 V=	1.1967	1.0629	.7778
Log. 5.42=	.7340	.7340	.7340
Log. $(P+rp)$=	1.9307	1.7969	1.5118
$\therefore (P+rp)$=	85.23	62.64	32.49 lb.

In the trials of a given vessel, a multiple of this curve has been named "indicated thrust," and for this reason in Messrs. Inglis's figure, the "mean pressure curve" and "indicated thrust" are both represented by the same curve, and we have only to employ a different scale for reading off the one or other. We would labour under a great mistake, however, if we suppose that this gives the thrust of the shaft, as it would be measured by a dynamometer. It is only a hypothetical calculation of this quantity founded on very inexact assumptions.

Again, as to the curve of coefficients, of which we may take as the type the value of $\frac{M V^3}{E}$ (the ratio of the product of the immerged mid area and cube of the velocity to the gross indicated power). This, as has often been explained, is founded on an approximate statement of the expenditure of power in propelling a vessel, according to the old principle of *vis viva*.

It may be stated thus: the mass of displaced water in the vessel's motion is supposed proportional to the product of the immerged midship section and the velocity; this is the *quantity* factor: the velocity with which the water is displaced being supposed proportional to that of the vessel, the intensity varying according to the square; the product of quantity and intensity gives us a quantity proportional to the work done, whose ratio to the gross indicated power is the value of the coefficient. This forming a curve, as illustrated in Messrs. Inglis's figure, we may infer that it is not constant but variable. So far from this, however, being an indication of one speed of the Charles Quint being more efficient than another, it simply shows the *insufficiency* of the assumed value of the intensity factor, employ the true value of the intensity factor, and one speed gives the same coefficient as another. Hence it is, in trials of the same vessel under the same circumstances, such a curve as a measure of comparative efficiency at the different speeds, is meaningless, and any deduction from it simply misleading.

To leave this for another instructive example, we may refer to the trials on H.M.S. *Jumna*, as given in the Admiralty Tables arranged and condensed in the table.

It is assumed the heading of the several columns are sufficiently explicit; we may note in the sixth are given the logarithms of the natural numbers in the fifth column, and by simply subtracting the middle figures of each triad from the figures immediately over and under it, we have the seventh column values which are laid down to scale, as in Fig. 3, by the following successive steps.

Take a part of the speed axis between the 10 and 15 miles (it will readily be seen that it is quite unnecessary to waste space by drawing the figure in full to the origin) and, by scale lay off along it the six trial values of V, in natural numbers. Draw perpendiculars through these the 10 and 15 mile points, and on the former mark off ordinates equal to the power and revolution differences in the seventh column. Now draw the power normal P Q, which, for reasons to be explained, is passed through the two lowest and two highest speed points, but falls under the two mean speed points.

Then, take the difference between the lengths of the 10 and 15 mile ordinates. By scale this is .417, very nearly, one fifth of this, or .0833, is the value of the intensity coefficient a.

Again, from 2.1362, the value of the ordinate to the power normal at speed 10, subtract .833, the value of the intensity factor, and the remainder 1·3020 being the value of the logarithm of 20.05, this latter number is the value of the initial or quantity coefficient b, whence the equation of the power curve of

$$\text{H.M.S. } \textit{Jumna}, \ E = 20.05\ V \log.^{-1} .0833\ V.$$

Next, draw R S, a revolution normal, and treating its ordinates in exactly the same way, we get the corresponding revolution curve:

$$N = 2.773\ V \log.^{-1} .0138\ V.$$

Now, it is reasonable to suppose, in this vessel, where screws of extremely varied pitches have been tried, one revolution normal, implying no change in circumstances, cannot meet the case where a 21 ft. pitch screw is altered successively into 32 ft. 6 in., 27 ft. 6 in., and 25 ft. 6 in. pitched screws. In some way the formula for N must involve the pitch of the screw; and it is not difficult to find, that it influences the value of this element, in the inverse ratio of the cube root of the pitch; and the foregoing formula, to meet this case, takes the form:

$$\text{H.M.S. } \textit{Jumna}, \ N = \frac{7.838}{H^{\frac{1}{3}}} V \log.^{-1} .0138\ V.$$

In which, H (helix) denotes the pitch of the screw in feet; and calculating the values of E and N for the various trial speeds by these formulas, we obtain the following Table:

Here we see in trials (1), (3), and (5), that is to say, at highest speed and least pitch, average speed and pitch, and lowest speed and greatest pitch, the formula values agree perfectly with the observed values of the power and revolutions: the power for (6) also agrees, whilst that for (4) differs considerably,

H.M.S. "JUMNA."

Trial.	V. Speed.	E. Formula	E. Trial.	Differences.	N. Formula	N. Trial.	Differences.
(1)	14.66	4890	4894	— 4	66.36	66.47	— .11
(2)	11.77	2255	2466	—211	48.61	53.34	—4.73
(3)	10.36	1515	1507	+ 8	35.37	35.11	+ .26
(4)	12.52	2771	2903	—132	48.40	49.80	—1.40
(5)	12.87	3046	3044	+ 2	51.60	51.50	+ .10
(6)	10.82	1728	1733	— 5	40.64	41.99	—1.35

TRIALS OF H.M.S. "JUMNA."

Vessel's length, 360 ft. Breadth, 49 ft. 1½ in. Single four-bladed screw.
Trials (1) to (3), engines common, three cylinders 77 in. diameter, 4 feet stroke.
" (4) to (6), " compound, one cylinder 58 in. and two 77 in. diameter, 4 ft stroke.

Number of Trial.	Place. Time. Wind.	Draughts. Mid Area. Displacement.	Screw Diameter. Pitch. Length.	Power. Speed. Revolutions.	Natural Numbers.	Logarithms of Numbers.	Logs E and N each diminished by Log V.
(1)	Plymouth	17,8 forward 21,10 aft	21,0	E	4894	3.6897	2,5236
	June 27, 1867	836 sq. ft.	21,0	V	14.66	1.1661	
	Wind, 3	6076 tons,	1.6½	N	66.47	1.8226	.6565
(2)	As in (1)	As in (1)	As in (1)	E	2466	3.3920	2.3212
	Do.	Do.	Do.	V	11.77	1.0708	
	Do.	Do.	Do.	N	53.34	1.7271	.6563
(3)	Stokes Bay	16,7 forward 21,8 aft	21,2	E	1507	3.1781	2.1627
	Sept. 6, 1872.	810	32,6	V	10.36	1.0154	
	Wind, 6	5866	4.5¾	N	35.11	1.5454	.5300
(4)	Stokes Bay	16,9 forward 22,6 aft.	21,2	E	2903	3.4628	2.3652
	Oct. 13, 1873	835	27,6	V	12.52	1.0976	
	Wind, 2 to 3	6058	4.2¼	N	49.8	1.6972	.5996
(5)	Stokes Bay	17,7 forward /2,16 aft.	21,2	E	3044	3.4834	2.3738
	Oct. 5, 1875	831	25,6	V	12.87	1.1096	
	Wind, 5 to 6	6024	4,1	N	51.50	1.7118	.6022
(6)	As in (5)	As in (5)	As in (5)	E	1733	3.2388	2.2046
	Do.	Do.	Do.	V	10.82	1.0342	
	Do.	Do.	Do.	N	41.99	1.6231	.5889

and referring to Fig. 3 it is seen to fall above the power normal by a small amount. The revolution spot for (4) is also seen to lie on the normal agreeing with a 25 ft. 6 in. pitch screw, which is not consistent with the fact that in this experiment the pitch is 27 ft. 6 in. Either by an error of observation the revolutions have been overstated, or there has been some change in circumstances equivalent to a reduction in the pitch. Obviously, if the revolution spot ought to be lower, the power spot would follow it in sympathy, and from this, and the concurrent testimony of four out of the six experiments, the normal value of the power spot has a far greater probability of being correct than the observed abnormal one.

Similarly, the power spot of (2) is as much above the normal as the revolution spot is above the proportional normal for the 21 ft. pitch screw. The differences, in this case, are too great to be ascribed to error of observation. Like the trial (4) of the Iris, this is very probably a case of the intrusion of one of the values from the related conjugate curve which we find presented by sister vessels, or even by the same vessel when circumstances, neither clearly understood nor defined, seem to cause sudden changes from the one to the other.

The remarkable inference from the power normal of the Jumna is the apparently total absence of any effect due to the various propellers, or change of the engines from common to compound. A coarser pitched screw gives fewer revolutions; but in respect to the power for a given speed, this is practically the same with all!

Another illustration of the nature of and marked difference in results presented by practically similar vessels may be drawn from the Admiralty trials of the *Euryalus* and *Bacchante*. In the following Tables are given the various elements and trial data directly affecting the question; and, together with these, the figures and logarithmic differences necessary for drawing the power and revolution normals, as laid down in Fig. 4, page 234.

H.M.S. "EURYALUS."

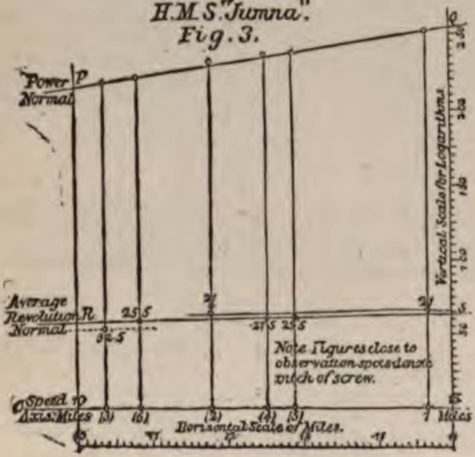
Stokes Bay ... July 5, 1878 ... Wind 4 to 5 ... Sea Smooth.
Ship's length ... 280 ft. ... ... Beam ... ... 45 ft. 6 in.
Drght. for., 21 ft. Aft, 23 ft. 6 in. ... Mid a., 802 ... Displ. 4223.
Cylinders ... ... one 73 in. ... ... two 92½ in. ... 4 ft. stroke.
Screw, two blades Dia., 20 ft. 6 in.... Pitch, 24 ft. 3 in. 4 ft. 2 in. long.

Trial Data.		Natural Nos.	Logs. of Do.	Differences.
	E	5109	3.7083	2.5405
(3)	V	14.72	1.1678	
	N	71.49	1.8542	.6864
	E	3468	3.5401	2.4207
(4)	V	13.16	1.1194	
	N	62.65	1.7970	.6776
	E	1805	3.2565	2.2231
(5)	V	10.80	1.0334	
	N	49.51	1.6947	.6613

H.M.S. "BACCHANTE."

Strokes by ... ... July 30, 1879 ... Wind 1 to 2 ... Sea smooth.
Ship's length ... 280 ft. ... ... Beam ... .. 45 ft. 6 in.
Draught for., 21 ft. Aft, 23 ft 4 in.... Mid a., 785 ... Displ. 4126.
Cylinders ... ... one 73 in. ... ... two 92 $\frac{1}{16}$ in. ... 4 ft. stroke.
Screw, two blades Dia., 20 ft 10 in. Pth. 22ft. 11½in. 4 ft. 7½ in l.

Trial Data.		Natural Nos.	Logs. of Do.	Differences.
(2)	E	5416	3.7337	2.5559
	V	15.06	1.1778	.7031
	N	76.02	1.8809	
(3)	E	3571	3.5528	2.4183
	V	13.63	1.1345	.6874
	N	66.36	1.8219	
(4)	E	1927	3.2849	2.2171
	V	11.69	1.0678	.6656
	N	54.13	1.7334	


H.M.S."Jumna".
Fig. 3.
Power Normal
P
Average Revolution Normal
R
25 S
32.5
27 S
25 S
Note Figures close to observation spots denote pitch of screw.
Vertical Scale for Logarithms
0 Speed Axis: Miles
(3)
(6)
(2)
(4)
(5)
Miles
Horizontal Scale of Miles.

It will be found that the various normals pass through the observation spots with almost perfect accuracy, and proceeding in exactly the same way as with former examples, we obtain the following equations:

$$\text{Euryalus, } E-22.30\ V \log.^{-1}\ .081\ V.$$

$$\text{Bacchante, } E=11.03\ V \log.^{-1}\ .1005\ V.$$

$$\text{Euryalus, } N=3.913\ V \log.^{-1}\ .0064\ V.$$

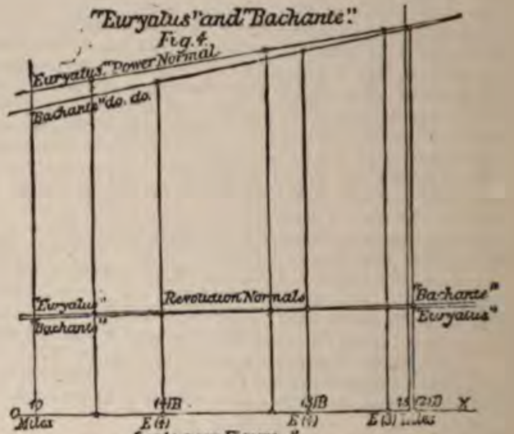
$$\text{Bacchante, } N=3446\ V \log.^{-1}\ .011\ V.$$

Comparing the two first equations, or looking at the power normals Fig. 4, it will be seen when V=15.68, both equations give the same value 6512, the indicated power which would he required for this speed by both vessels; but at 10 knots the *Euryalus* requires 1440 indicated, while the *Bacchante* would only require 1116! No doubt there are slight differences in draught, trim, pitch of screw, and weather, but in the *Jumna* these were as much or even more varied, without producing any noticeable effect upon the power normal. The conjugate solution indicates two distinct ways in which currents in the water displaced by the vessel's motion influence the action of the propeller; with similar vessels, it is a question of circumstances as to which of them will predominate, and in a series of experiments it is quite possible to have one or more values of the one mixed up with values from the other.

In concluding this note an explanation is offered on a subject which is found confusing. In two letters at the end of this article is given some values of the intensity coefficient a, and corresponding calculated values of a coefficient C such that $\frac{L\sqrt{M^{\frac{1}{3}}}}{C}$, is equal to the inital or quantity coefficient b of my formula. As explained, the numerator of this fraction is a practical approximation to the proportion of power expended, due to the absolute dimensions of the hull, and C a coefficient involving several variable elements, but constant for a particular set of circumstances, so long as these do not vary.

These C coefficients are comparable with each other, as a measure of the efficiency, provided the intensity coefficients in the several vessels have the same value, which is very seldom; and to get comparable values, it is necessary to condescend upon some special value of the speed, and we can then transfer the effect of the variations of a from an assumed standard, to new values of C, which are then comparable, in respect to the special speed for which they have been calculated. Thus, in the following Table:

Actual Values.			Assumed particular Value. a=0707.		
			Values of Coefficient C.		
Vessel.	Intensive Coefficient a.	Efficiency Coefficient C.	For V=10.	For V=13⅓.	For V=15.
Iris ii. ...	.0707	120.4	120.4	120.4	120.4
Iris iv. ...	.0750	157.1	142.3	137.7	135.4
Shah	.0792	145.7	119.8	112.3	108.7
Euryalus ...	.0810	115.2	90.9	84.0	80.7
Jumna ...	.0833	162.7	121.7	110.5	105.3
Charles Quint	.0842	294.1	215.5	194.3	184.6
Comus ...	.0920	152.3	93.3	79.2	?
Bacchante ...	.1005	231.4	116.5	92.7	82.7
Firebrand ...	.1380	388.9	82.6	?	?


"Euryalus" and "Bachante".
Fig. 4.

Scale as in Figure. 3.

In explanation, the actual value, columns a and C, are followed by three calculated values of C, for the speeds 10, 13⅓, and 15 knots; a being taken as .0707, the actual value for Iris ii.; and, hence, the efficiency coefficient for this vessel does not vary. For the other vessels, the actual values of C are divided by the number having its logarithm the difference between the actual and assumed values of a, multiplied by the assumed speed. Thus, for column V=10, the difference between a for the Firebrand and .0707 is .0673, which multiplied by 10, the number corresponding to this by the Tables is 4.71, and the general value 388.9 divided by this gives 82.6 as the efficiency coefficient for this vessel, which compares with all the other coefficients in this 10 knot column. Again, for column V = 15, the Bacchante value of *a*, .1005 less .0707, multiplied by 15, gives .4470; the number corresponding to which by the Tables is 2.8. The general value of C, 231.4, divided by 2.8, in like manner gives 82.7 as the efficiency coefficient which compares with all the figures in the 15 knot column.

The reason of this process may be traced from the consideration in effect, having assumed V = 15, then, that is to say, having made

$$\frac{\log.^{-1} .1005\ V}{231.4} = \frac{\log.^{-1} .0707\ V.}{82.7}$$

an arbitrary change on the intensity coefficient, we make a change on the quantity coefficient, so that their ratio is unaltered from that of the actual values.—*Engineering.*

SIR,—In your present issue you publish the speed curves of the steamers *Charles Quint* and *Shamrock*. The Messrs. Inglis certainly deserve the thanks of all shipbuilders by their adding fresh data to our available stock of information as to the capabilities of steamers at trial draught. The curves of indicated horse-power are shown in each case passing through the zero point, but the late Mr. Froude proved that this should not be, the curve ought to start at a distance along the base line representing the initial friction of the engines. Some months ago there was published in *Engineering*, an article by Mr. Mansel, of Glasgow, on the subject of the law of resistance of steamships. In the accompanying Table are the values of his coefficients *a* and C worked out for the two vessels in question, also for several others of which the performances have been published. Mr. Mansel's formula does not seem to have received the notice it deserves, as it gives the *true* law of reuistance, the values of C for the Iris being remarkably uniform. It would appear that for all ordinary purposes a trial at two speeds is sufficient, one at somewhat under the maximum and one at half power answer well. Very little published data as to performance at *load* draught exists, the Peninsular and Oriental trial sheet may be considered out of date; if you, Sir, would kindly take up the subject you would confer a lasting favour on the profession. Surely abundance of facts as to the sea-going performance of trading and passenger steamers exists in the country, and might be published with loss to no one, and great gain to all.

Name of Vessel.	Builder.	Length.		Breadth.		Draught.		Displacement.	Section.	Speed.	Indicated Horse Power.	*a*.	C.
		ft.	in.	ft.	in.	ft.	in.	tons.	sq. ft.	knots.			
Shamrock, s.s. ...	Inglis	231	0	33	2	11	7½	1296	309.5	9.4	370	.105	354
										12.9	1130	"	365
										13.9	1630	"	353
Charles Quint, s.s.	Inglis	313	6	33	6	14	7¾	2478	420	9.7	480	.079	253
										13.5	1330	"	254
										15.1	2062	"	245
Grangemouth, s.s.	Paul	195	0	27	0	12	10	1124	300	7.36	160	.1285	496
										8.78	291	"	495
										9.88	441	"	509
										10.77	725	"	440
Houssa, t.s. ...	Steven	192	0	26	0	6	8	645	164	7.108	132	.09	216
										8.878	323	"	219
										10.69	430	"	211
Iris, t.s.	H.M.S.	300	0	46	0	18	1	3290	700	8.32	596	.069	134
										12.47	1765	"	127
										15.74	3958	"	125
										18.58	7556	"	129
Miranda, s.s. ...	Thornycroft	45	6	6	6	2	6	3.73	10	10.27	23.45	.03	68.8
										14	42.31	"	67.3
										16.19	56	"	68.4

Yours truly,
SHIPBUILDER.

SIR,—A correspondent, "Shipbuilder," has given some results of his calculations upon an important subject; one that has long occupied my attention. It may assist to confirm his argument to point to a few alterations which would bring his results into still closer agreement with observed facts. I have not examined most of the vessels to which he has referred, and will only give my deductions upon two of them, but I may refer to a few of the "Results of Trials made on Her Majesty's Screw Ships and Vessels," as recently published by the Admiralty. It will be seen that these in a conclusive manner confirm the principle illustrated by your correspondent. The recent system of making these trials with, approximately, full power, two-thirds power, and one-third power, are especially valuable for the purpose. With very low powers, tidal and wind drift is not properly eliminated by the system usually followed, and residual errors, though really small, mark the true result due to those low powers.

First, as to the s.s. *Charles Quint* having read off the data from Messrs. Inglis's published curves, with as much accuracy as their small scale would admit of; it seems to me the value of the coefficient *a* may be taken as .0842; and that in the trial of the twin-screw vessel M.M.S. Iris, to which reference is made by your correspondent, this coefficient should be taken as .0750.

With these and the other necessary data given in the above Table we then derive the values of C given in the iast column. To these have been added another of the Iris trials and the data and calculated values of C in the case of the following single-screw vessels of the Royal Navy: *Shah*, *Euryalus*, *Comus*, *Bacchante*, and *Firebrand*. The law of the power being $E = b\ V \log._{-1} a\ V$; in which, as a practical approximation, it is assumed that

$$b = \frac{(L\sqrt{M})^{\frac{7}{8}}}{C}$$

With the given construction elements and trial data, we resolve for C by the deduced formula:

$$\text{Log. } B = \tfrac{7}{8}\left\{\log. L + \tfrac{1}{2}\log. M\right\} + \log. V + a\ V - \log. E.$$

Notwithstanding the great variations of power and speed, in most cases, for each vessel, this coefficient comes out practically constant; the small differences in the middle terms, too great in some, and too little in others, show them to be mere results of errors of observation, which, in determining *a*, have been assigned to this middle term; instead of, with greater probability, affecting all the three, and consequently the deviations from a mean value even less in amount! I would also beg to note a disclaimer. A paper of mine to which I think your correspondent refers was not on "The Law of the Resistance of Steamships," but on "The Law of the Power required for Different Speeds of the same Steam Vessel." In this latter inquiry we are treating on a subject which is a matter of direct observation. The former subject of inquiry, in most cases, is only a mathematical abstraction founded on hypotheses which can not be directly verified, and when referred to the really fundamental and important inquiry of the power and speed relation, must signally fail!

ROBERT MANSEL.

IT is reported that the Chinese Government through its Amdassador at Berlin, has just completed a bargain with the Vulcan Shipbuilding Company at Stettin for the construction of a formidable ironclad. The vessel is to be a double-turreted frigate with five guns of about 32 centimetre calibre, and of the same class as the *Preussen* and the *Grosser Kurfurst*. It is to be finished in 18 months.

POWER CURVES OF SCREW STEAM VESSELS.

Name of Vessel.	Number of Trial.	Trial Data.				Value of Coefficient *a*.	Value of Coefficient C.
		Length on Water Line.	Mid Section.	Power Developed.	Speed Corresponding.		
		L.	M.	E.	V.		
Charles Quint	...	313	420	2062	15.11	.0842	294.0
				1318	13.42	"	294.5
				480	9.82	"	293.8
Iris	(14), (15), (16)	300	700	7556	18.59	.0750	157.6
				3958	15.75	"	156.1
				1765	12.48	"	157.7
Iris	(6), (7), (8)	300	700	4368	15.73	.0707	120.4
				3306	14.52	"	120.5
				1637	11.58	"	120.4
Shah	(5), (6), (8)	334	986	7477	16.45	.0792	145.7
				2506	12.13	"	145.8
				318	5.32	"	145.6
Euryalus	(3), (4), (5)	280	802	5109	14.72	.0810	115.8
				3468	13.16	"	114.1
				1805	10.80	"	115.8
Comus	(2), (3), (4)	225	583	2447	12.93	.0920	151.6
				1646	11.65	"	154.8
				770	9.12	"	151.5
Bacchante	(2), (3), (4)	280	785	5416	15.06	.1005	232.0
				3571	13.63	"	228.8
				1927	11.69	"	231.7
Firebrand	(2), (3), (4)	125	198	458	10.17	.1380	388.6
				303	9.20	"	389.0
				179	7.98	"	389.0

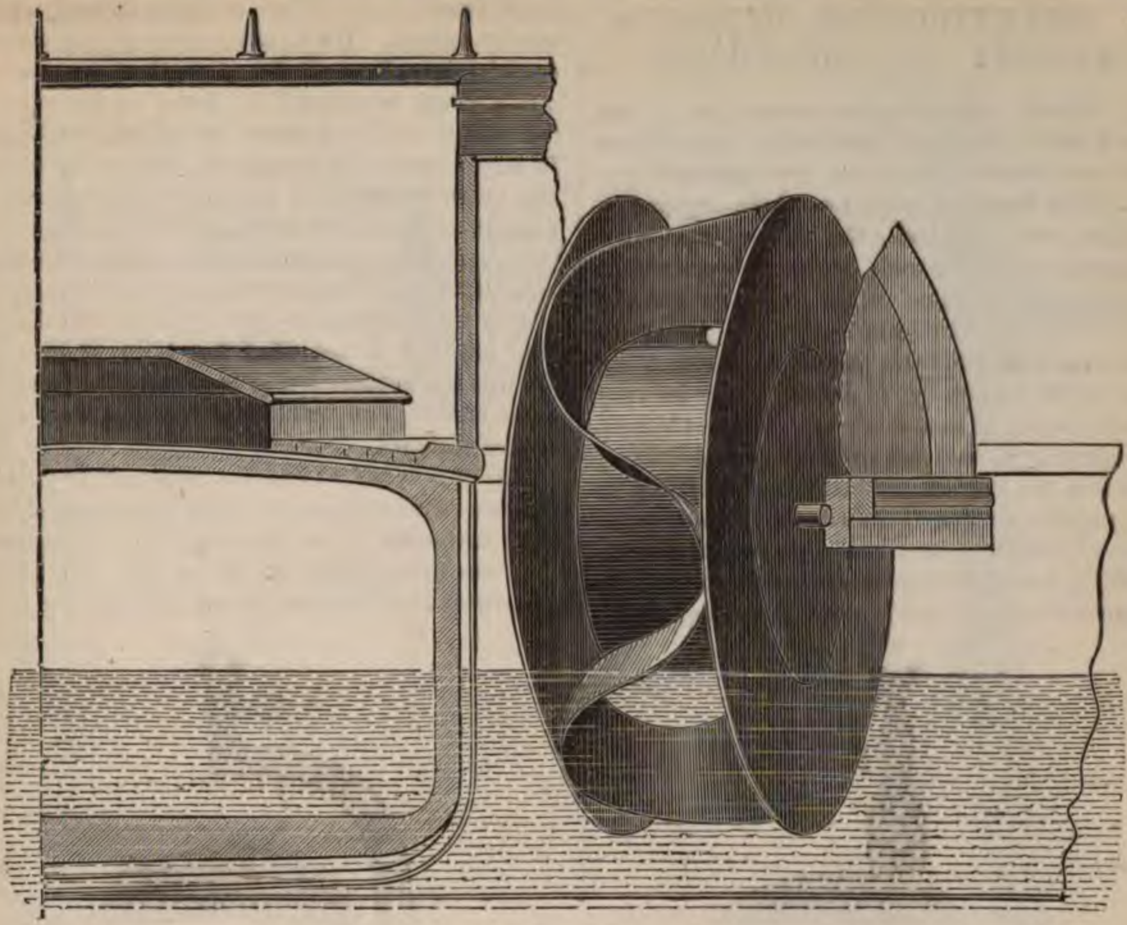
THE PROJECTED HARBOUR CONSTRUCTION AT WICKLOW.

(From our Correspondent.)

THE last of the Extraordinary Presentment Sessions for deciding as to the guarantee of £40,000 for the construction of a harbour at Wicklow, was held on the 21st. in the County-court House for the barony of Arklow. Colonel Tighe, D.L., Chairman of the Harbour Commissioners, explained the nature of the guarantee, pointing out the advantages which would accrue to Wicklow and to the county at large, by the formation of a harbour. Dr. Toomey (Dublin) appeared on behalf of the Earl of Carysfort, and the Earl of Wicklow to oppose the guarantee, and argued that the barony of Arklow could not be fairly asked to contribute, inasmuch as the Arklow people wanted to secure a harbour for the town. Mr. Corbett, M.P., supported the guarantee, and said the people of the county had been waiting for many years for individual support, but they were now resolved to appeal to the feelings of the cesspayers of the entire county, who would cordially assist Arklow as well as Wicklow. Mr. M'Phail, as a town commissioner of Wicklow, and a Poor Law guardian, deprecated the opposition by Lord Carysfort to the guarantee. The people of Arklow, through their parish priest, had addressed the Rathdrum Board of Guardians in reference to the great distress which at present existed in that town, and had applied that the provisions of the Relief of Distress Act should be put into force. He was, therefore, much surprised that the nobleman who was lord of the soil, should now come forward to oppose an undertaking which would afford employment to hundreds of poor persons, and thereby materially reduce the rates. The interests of Wicklow and Arklow were identically the same; and all local jealousies should be extinguished, and an united effort made for the benefit of the two ports. Lord Carysfort regretted he could not withdraw his opposition. He did not believe that Wicklow would suit as a harbour of commerce, inasmuch as it was too near Dublin. Arklow had a far greater claim, as it was the principal fishing port on the east coast, and was adapted to the requirements of the general public. He did not think it was fair to ask the barony of Arklow to take part in the guarantee. Dr. Toomey said he had a memorial from cesspayers in the barony of Arklow, the valuation of whose holdings amounted to £30,000, and they were against the guarantee. Mr. Speares, on the part of Earl Fitzwilliam, said his lordship was proprietor of by far the larger portion of the county, and under the Relief of Distress Act would have to pay half the special cess levied. Earl Fitzwilliam gave his most cordial support to the guarantee, and wished it every success. Colonel Tighe mentioned that the other four baronies had unanimously voted for the guarantee. All the associated cesspayers and six magistrates voted for the guarantee. The justices who voted against it were: The Earl of Carysfort, Colonel Bayly, Colonel E. R. Bayly, and Messrs. Acton and Ruskell. As a consequence of this result the town was brilliantly illuminated.

THE *Cronstadt Messenger* reports that the construction is projected of a new ironclad of 12,000 tons upon the same system as the *Livadia*.

IT is computed that the number of vessels launched last year at the Hartlepools will be close on 30, if not more, which far exceeds the number launched at those Ports in any previous year. It is stated to be in contemplation to extend one of the principal yards by laying down additional launching berths, as, from the orders now on hand for new vessels, there is every likelihood that the number of launches will be greatly increased next year. The vessels that have been constructed this year have nearly all been steamers, so that the marine engine-works have been kept in full employment during the year. All the vessels launched at Hartlepool last year have been iron, with ehe exception of one vessel which was built of Siemen's steel.



A NEW PROPELLER.

A NEW PROPELLER.

THIS invention forms the subject of a patent taken out by Messrs. McLennan & Owen. Though described in language appropriate to a new propeller or screw, its aim will be more readily understood if it be denominated an improved paddle-wheel. The wheels are placed at the sides of the vessel, and revolve in the same manner as ordinary paddles. Bearing this point in view, and referring to the very clear illustration we give, the reader can have no difficulty in detecting the inventor's object, and understanding the mode of construction of the apparatus.

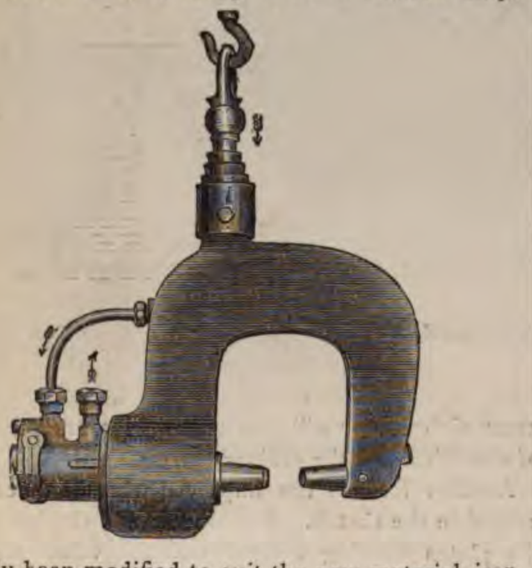
Primarily, the ordinary paddles are replaced by a species of endless screw, fixed in the manner shown, between parallel walls. When the wheel is partially immersed, the water will consequently be enclosed in a species of chamber, and will thus, it is presumed, present a more solid resistance to the blows of the wings, correspondingly increasing the speed of the vessel. The inventor claims that this lateral confinement of the water will produce an advantage in speed of one-third over the ordinary screw.

Another form of the improved wheel is that represented in the sketch. Here the core is a hollow drum, the plates forming flanges and the wheel when at work will be immersed to the lower surface of the drum. This formation will, it is claimed, tend to increase the vessel's steadiness and power of flotation, and also prevent the lateral wash which is such an objection to the use of steam in canals and rivers.

It is of course impossible to judge decisively of an invention such as this, before it has been practically and thoroughly tested, not only in smooth water but at sea. It is important that such an experiment should be made, for in these days of competition no one can afford to despise any advance towards increased speed in their vessels, or diminution of power necessary for a given speed. We are glad to hear this task has already been undertaken by a northern firm, and we shall then be able to chronicle the results obtained, which will, we believe, prove satisfactory.

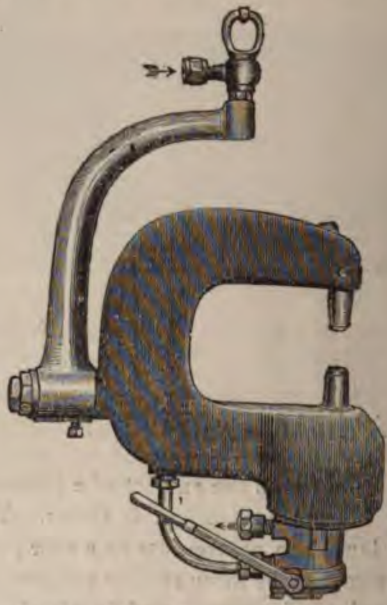
THE APPLICATION OF HYDRAULIC MACHINERY TO SHIP-BUILDING.

THE methods pursued in the construction of iron and steel ships and steamships must always possess considerable interest to the readers of this journal. We have for some time been engaged on this subject, and, considering the national importance of this branch of British trade, we have always wished that the careful attention of our engineers and tool makers should be directed not only to improving the present somewhat primitive modes of working, but also to render employers of labour in this industry more independent of skilled labour. The first impression received by an engineer on visiting a ship-building yard, is that the present method of constructing or putting together an iron vessel can only be a tentative one, and to those who have had experience in wooden shipbuilding it is quite evident that the general system of construction as formerly used in wooden ships has only been modified to suit the new material, iron and steel. In place of the oak frames, we have angle iron frames and reverse bars, rivetted together in such a manner as to render easy the attachment thereto of shell plating and stringers. In place of the outer and inner planking and ceilings we have now steel plating, and we see the oaken trenails superseded by rivets. But the general construction and arrangement of parts is the same, excepting that owing to the different properties of the materials employed, considerable differences in the details of construction are necessary. We must not, however, forget that other modes of construction have been adopted in some cases and proposed in others, but still, it may be said that at the present time ninety-nine ships in every hundred are built with vertical frames, corresponding in all essential particulars to those formerly used in wooden vessels. We do not purpose in this article to consider how, if at all, the strength of a vessel as a whole would be affected, for better or for worse, by the adoption of any other method of construction. It may however, be considered, that, if, by adopting any other formation of framing or plating, we can without any loss of strength, enable machinery to be employed instead of manual labour in the construction and erecting, we clearly gain a great advantage.



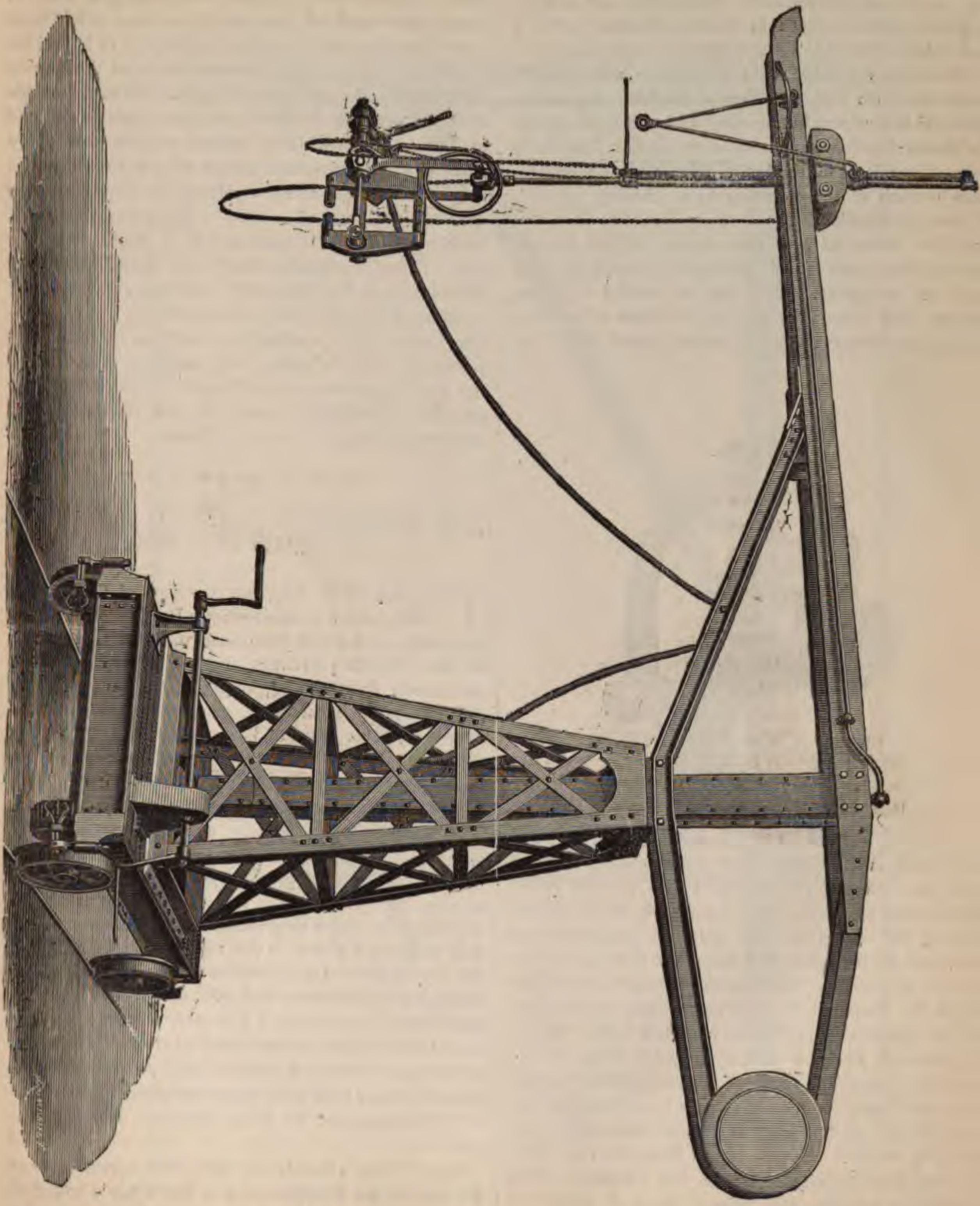
At present however, we have to deal with affairs as they are, and to see what has been accomplished towards the substitution of machinery for hand work in the erecting and building of iron and steel vessels as now designed.

Taking a vessel as now put together, and looking at it from the point of view of an engineer wishing to apply machinery to the rivetting up of the structure, no worse arrangement, so far as the ship itself is concerned, could well be devised, and looking further ahead we will find that the vessel is built as a rule under no cover and entirely unprovided with overhead travellers, cranes or other means of carrying or manipulating either the materials or tools used in construction.



In addition to this, the vessels while building being packed close together, render it almost impossible to apply machinery to the surface of train shells for rivetting them up.

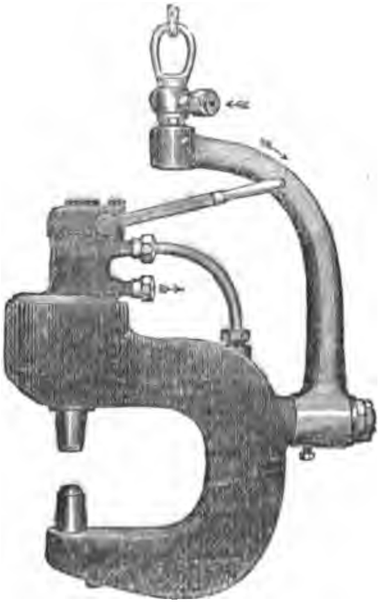
So far as the moulding of the frames is concerned iron and steel are very suitable and convenient, and generally speaking also these materials are very well suited to enable good attachments to be made in the plating and also in such cases as that of fastening the



THE APPLICATION OF TWEDDELL'S SYSTEM OF HYDRAULIC MACHINE TOOLS TO SHIP-BUILDING.

garboard strakes to the keel bars, &c. &c., while by means of angle irons the irons and plates used in the various modifications of the bracket and cellular system, great strength is readily obtained with a minimum of weight.

But when all these parts have to be connected to each other, we find ourselves dependent very much on hand labour and human skill, and although, as will be shown shortly, we can now—thanks to Mr. Tweddell's unceasing efforts for the last ten years—do a considerable portion of the rivetting by machinery, yet still, if iron ship-builders are ever to be free from the troubles connected with this class of skilled labour, we think that some considerable and important changes will be necessary. Not only is skilled rivetting labour very expensive, but in no class of work is inferior workmanship more easily passed off. The work itself is little better than stonebreaking and no good man should be required to do it. On boiler making and bridge building, handwork is rapidly becoming the exception, and hydraulic machinery the rule, and we trust that in a few years this may be the case in ship-yards. On a recent occasion, when Mr. Ralph H. Tweddell, C.E., Westminster, read a paper on his system of "Hydraulic machine tools," Mr. J. K. Jameson, lately a partner in John Elder & Co., said that "personally he had no hesitation in saying they would see them very largely introduced into all new works," and similar favourable testimony was borne by others. We this month illustrate two forms of crane, fitted with hydraulic lift, and rivetters on Mr. Tweddell's patents, also minor views of a form of portable rivetter, largely used for rivetting frames and beams. Space prevents any detailed description in this number, but in a future article we shall describe them more fully and also some later applications. When we mention that in some yards each of these machines can put in from 1,500 to 1,600 nuts 1 in. dia. per day of 10 hours, we think that there cannot be much doubt of their being very largely adopted; some hundreds of these portable rivetters are now at work in all parts of the world, and in fact, Mr. Tweddell's system may be now fairly classed as an important branch of the machine tool industry. So far as the rivetting machinery on this system is concerned, a visit to the works of Messrs. Fielding & Platt, at Gloucester, is a most interesting one. These gentlemen are not only the sole licencees and makers of Mr. Tweddell's rivetting machines, but in many recent designs co-patentees also. There are also many other applications, such as for punching, shearing, and bending, and amongst other yards, the well known arsenal at Toulon is entirely fitted up on Mr. Tweddell's system, by the Hydraulic Engineering Company Limited, Chester.



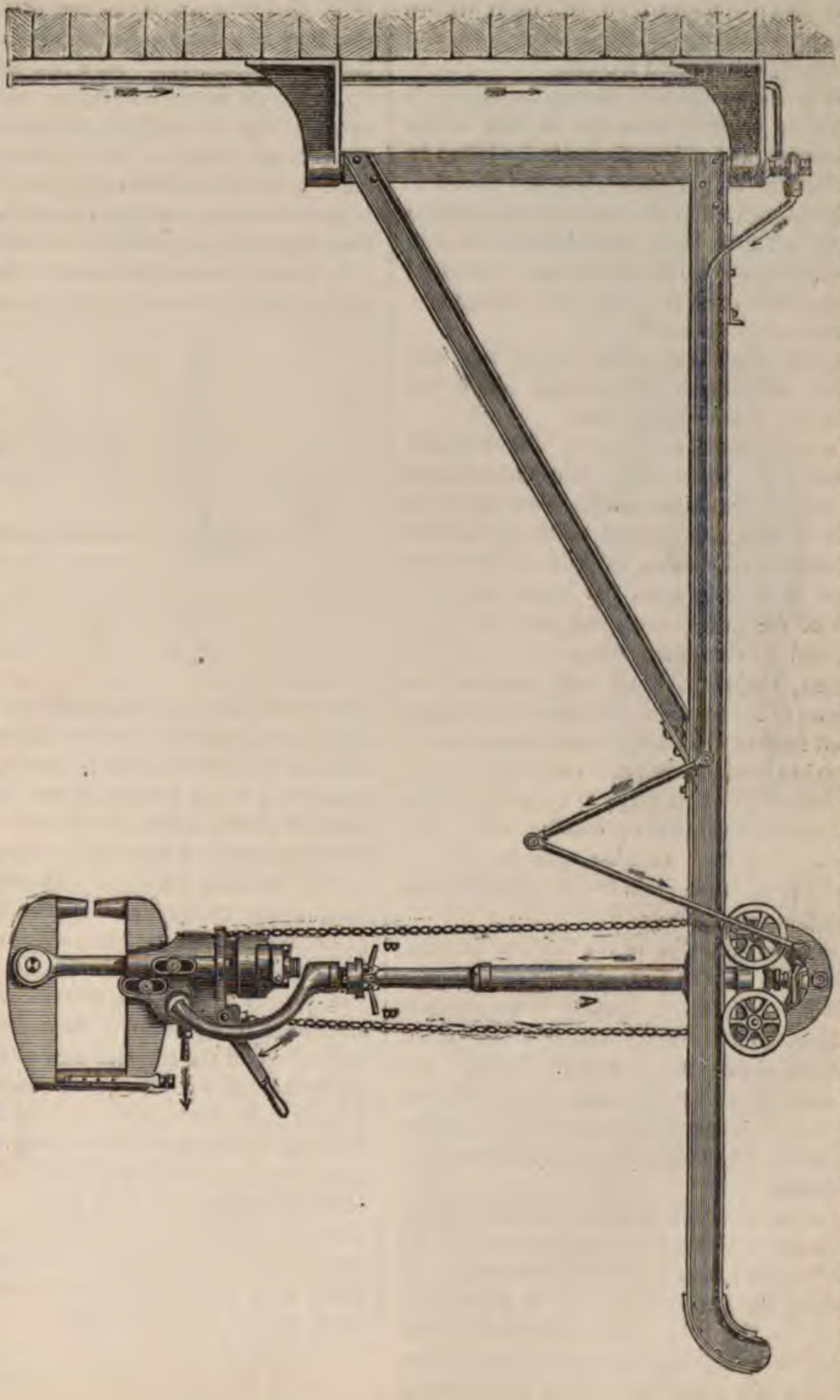
THE MERCHANTS' SHIPPING (CARRIAGE OF GRAIN) ACT, 1880.

THE Merchants' Shipping (Carriage of Grain) Act, 1880, comes in force to-day. It was evident during the course of the year just passed that something would be done towards preventing the loss of so many ships, presumedly from shifting cargo, more particularly of grain, we say presumedly, because unfortunately some of them were never heard of, being lost with all hands, but being grain loaded it is only too probable that this was the cause. Doubtless, with some of them, if the grain had been properly trimmed and stowed, they might not have been lost, and though many experienced shipmasters say that with the present arrangements, with proper care in trimming, they have no fear of the grain shifting, it is evident that many of them do shift, and anything that tends to prevent such a heavy loss of life and property is a step in the right direction; although the provisions of this Act are being severely criticised as needlessly burdensome and officious, it will certainly make some improvement; it should, therefore, be welcomed. and we have no doubt will be cheerfully accepted by all right thinking shipowners, and the necessary expense in fitting their ships up ungrudgingly provided.

The following are the most important clauses of the Act:—

"4. Where a British ship laden with a grain cargo at any port in the Mediterranean or Black Sea is bound to ports outside the Straits of Gibraltar, or where a British ship is lad w a grain cargo on the coast of North

THE APPLICATION OF TWEDDELL'S SYSTEM OF HYDRAULIC MACHINE TOOLS TO SHIP-BUILDING



WALL OR PILLAR CRANE WITH HYDRAULIC LIFT AND RIVETTER.

America, the following precautions to prevent the grain cargo from shifting shall be adopted; that is to say—

"(*a.*) There shall not be carried between the decks, or, if the ship has more than two decks, between the main and upper decks, any grain in bulk, except such as may be necessary for feeding the cargo in the hold, and is carried in properly constructed feeders.

"(*b.*) Where grain (except such as may be carried in properly constructed feeders) is carried in bulk in any hold or compartment, and proper provision for filling up the same by feeders is not made, not less than one-fourth of the grain carried in the hold or compartment (as the case may be), shall be in bags supported on suitable platforms laid upon the grain in bulk. Provided that this regulation with respect to bags shall not apply—

"(i.) To oats, or cotton seeds; nor

"(ii.) To a ship which is a sailing ship of less than four hundred tons registered tonnage, and is not engaged in the Atlantic trade; nor

"(iii.) To a ship laden at a port in the Mediterranean or Black Sea if the ship is divided into compartments which are formed by substantial transverse partitions, and are fitted with longitudinal bulkheads or such shifting boards as hereafter in this section mentioned, and if the ship does not carry more than one-fourth of the grain cargo, and not more than one thousand five hundred quarters in any one compartment, bin, or division, and provided that each division of the lower hold is fitted with properly constructed feeders from the between decks; nor

"(iv.) To a ship in which the grain cargo does not exceed one-half of the whole cargo of the ship, and the rest of the cargo consists of cotton, wool, flax, barrels or sacks of flour, or other suitable cargo so stowed as to prevent the grain in any compartment, bin, or division from shifting.

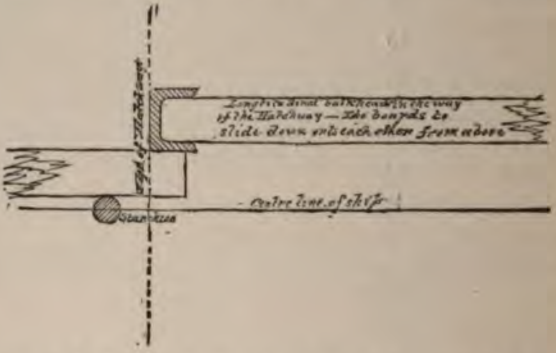
"(*c.*) Where grain is carried in the holds or between the decks, whether in bags or bulk, the hold or the space between the decks shall be divided by a longitudinal bulkhead, or by sufficient shifting boards which extend from deck to deck, or from the deck to the keelson, and are properely secured, and if the grain is in bulk are fitted grain-tight with proper fillings between the beams.

"(*d*). In loading the grain shall be properly stowed, trimmed, and secured.

"5. The precautions required by this Act to be adopted by ships laden with a grain cargo at a port in the Mediterranean or Black Sea, or on the coast of North America, shall not apply to ships loaded in accordance with regulations for the time being approved by the Board of Trade; or to any ship constructed and loaded in accordance with any plan approved by the Board of Trade."

It is evident from the comprehensiveness of clause (*c*) that in every instance with all constructions of ships there must be longitudinal bulkheads or shiftings boards extending from top to bottom and fore and aft of all grain carrying holds. It thus becomes a question of much importance as to how these are to be fitted so as to be done at a resonable cost, as well as durably and so that they may not be continually causing expense in repairing and replacing. As a rule they will not require to be removed in discharging or taking in other kinds of cargo, except in the way of the hatchways. Ships bringing grain home frequently carry coals out, and even with most kinds of general cargo they would not interfere with the loading; still they should not be fixed so that they cannot be removed if necessary.

A cheap and effectual mode of fixing these longitudinal bulkheads is shown in the accompanying sketch:—


Longitudinal bulkhead in the way of the Hatchway—the boards to slide down on to each other from above
Centre line of ship
Stanchion

Down each (fore-and-aft) side of the hatchways a channel iron is fixed vertically from the highest deck to the bottom of the ship, these channel irons should not be less than 4 in. by 3½ in. by ⅜ in., so as not to be easily damaged; they are placed a little on one side of the centre line of the ship, leaving a space wide enough for 3 in. planks to slide in between them and the stanchions supporting the deck beams amidships, the portions of the bulkheads extending between the hatchways or between them and the permanent transverse bulkheads are formed by laying 3 in. planks against the stanchions, the ends near the hatchways being secured effectually between the last stanchion and the channel iron as shown, and the other portions being fixed to the stanchions in any convenient manner. In the way of the hatchways the planks slide down on to each other from above, their ends being held firmly by the channel irons; each plank should be marked for its own place and kept for it. In this manner the cost will be principally confined to the first cost, but unless some such method is adopted there will be expense every time a fresh cargo is taken in, and extra time taken up in fixing the bulkheads.

The cost of using bags will of course be considerable, and they will be avoided as much as possible in consequence. It will be seen from clause (iii.) that they are not required with single decked ships from the Mediterranean or Black Sea, if they are divided into separate compartments or divisions containing not more than 1,500 quarters, and not more than one-fourth of the total quantity; as there are always two holds, if not more, and these are each to be divided longitudinally, if the holds have the same capacity in a ship carrying not more than 6,000 quarters the Act will be complied with; if any hold contains more than 3,000 quarters (a little under 600 tons), it will have to be subdivided by other transverse bulkheads; these should be properly fitted, and each plank marked and kept for its individual place.

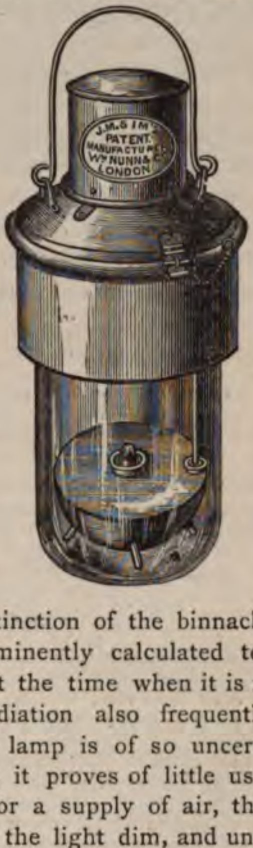
If a between decks is laid it will be necessary to carry a portion of the cargo on the upper decks in bags, and to have "properly constructed feeders" to the lower hold. It is unfortunate that the Act does not more particularly specify what will be considered "properly constructed feeders;" undoubtedly the best feeders for a lower hold from an upper hold are openings through the deck at intervals near the sides, and probably a convenient method of constructing the feeders would be, after filling the lower hold, to pile the grain in bags on the upper deck, leaving a gangway athwartships at the hatchway, leading into passages on each side over the feeding holes, the bags being shut in with boards strutted off from each other in the athwartships gangway, and from the sides of the ship in the fore-and-aft passages; these spaces could then be filled with bulk grain, this would settle down during the voyage, and, if it was necessary to do so at at any time, the crew could supply any deficiency on either side through the passages; otherwise, if it will be considered sufficient, the hatchway space itself after the upper deck is filled with bags can be trunked in, where it passes through the upper deck, and filled up with bulk grain.

When single deck ships are grain laden from North America, one-fourth of the cargo in each hold will have to be in bags laid on suitable platforms laid on the bulk grain, probably 1 in. boards will be considered sufficient to form this platform. If the properly constructed feeders are not provided for any lower hold it will have to have the one-fourth in bags the same as a single deck ship. It is possible also the single thickness of planks forming the longitudinal bulkhead may not be considered sufficiently grain tight, and will have to be formed in two thicknesses with the joints over-lapping.

Clause (5) opens out an opportunity for constructing ships with special provisions for grain carrying, and shows the existence of a feeling on the part of the authorities that they are willing to help forward any suitable scheme that will simplify and cheapen the cost of loading and carrying grain safely, and we think that with this encouragement it is more than likely that some special construction of hold, or arrangement that can be adopted to existing ships, will ere long meet with their approval, and if it should save the cost and trouble of carrying grain in bags it would have a large field before it, and the best wishes of everybody connected with this troublesome question.

SIM'S PATENT BINNACLE LAMP.

When all the manifold improvements in ships' fittings are noticed as they come up from day to day it becomes a matter of surprise how the marines were able to get on at all without the modern improvements which so soon come to be considered essential. The Binnacle Lamp is certainly one of the most important details for the safe steerage of a ship, as the sudden extinction of the binnacle light in rough weather is eminently calculated to endanger the steering just at the time when it is most important. The side irradiation also frequently given by the usual binnacle lamp is of so uncertain and dim a character that it proves of little use. There being no provision for a supply of air, the combustion is imperfect, and the light dim, and unsteady, and continual trimming is an absolute necessity. Owing to the proximity of the glass and the flame with no current of air to prevent contact, the glass is blackened and frequently broken by the flame when the vessel rolls.



Sim's Patent Lamp, however, is free from these defects. It is formed by a glass globe somewhat similar in appearance to that of an ordinary railway lamp. The oil lamp, however, is carried within the globe, and resting upon it on legs. Holes are pierced in the bottom of the glass globe to admit air for combustion, which as it enters strikes against the semicircular under side of the lamp, and is thus diverted into a uniform ascending stream around the glass. The light is thus preserved steady in spite of any amount of wind, and as the current of air is between the light and the glass, the latter is kept cool and cannot be cracked by the flame. When filled with pure colza oil and properly trimmed, the lamp will burn eight to ten hours without further attention. The lamp is let down in the top of the binnacle, the rest of interior of the dome being whitened to throw down the light by reflection on to the card. The chimney is made like those at present in use, perfectly water-tight, so that the lamp is not extinguished even by a sea breaking over it. A night shade is provided to keep the direct glare of the lamp from the eyes of the steersman, but of course this is not required in the day.

The cost of substituting this lamp for those in present in use is very small, as the present binnacle domes can be easily altered to receive the lamp. We see that a most satisfactory testimonial as to the value of the lamp in actual use has been given by Captain Hardy, of the ship *Cicero*. It seems to have been thoroughly tested at sea for a considerable period, and has proved itself the best binnacle lamp out.

THE DISC GUN.

By W. N. HUTCHINSON, General.

ABOUT this time last year I printed a memorandum on the subject for private circulation, but my warnings respecting the defence that might be expected from the adoption by ships of horizontal armour, met with so little attention that I felt it to be right to draw up an article for more extensive publication, and I will concisely summarise the purport of what I wrote in last August's *Macmillan*, and in three subsequent letters to the *Standard*, &c. &c.

The admirable manner in which the *Livadia* behaved in the bad weather she encountered on leaving Brest, seems to be as undoubted as her *present legal* right to enter waters forbidden to men-of-war. Her success shows conclusively that, without endangering their safety at sea, large ships without sides can have decks and bottoms sloped at so small an angle from a horizontal plane that, if judiciously armoured, all shots striking them would be deflected, while the recent improvement made in plates by facing them with steel shows that the armour need not be heavy—especially as the more horizontally it lies the less need be its thickness, the greater being the substance resisting penetration in the line of trajectory. Except by plunging fire, which would rarely prove effective, they could not be penetrated by our very best guns, because they impart a rotation that causes their shots to glance off instead of clinging, as it were to the slopes. Happily for us, though such ships cannot be struck at direct fire, with shots having a trajectory at right angles to their decks and bottoms, they can be struck with shots rotating in a plane at right angles to them, and having a rotation that gives them a clinging tendency. The more rapid such rotation the better. An efficient gun imparting such rotation becomes a matter of national importance, for if we fail in obtaining it, and small ironclads of the *Livadia* type can be made safe sea boats, our commerce may be destroyed by an enterprising enemy at the very commencement of hostilities. With the gradual adoption of that form for vessels of war, the manufacture of ordnance giving spiral rotation to projectiles will cease.

Perhaps it would be best to describe the gun by describing the shot, for, like a coat, it in a degree fitted the body travelling inside it. The gun, the shortest that could be made, somewhat resembled a mortar of an elliptical shape. You appropriately compare the disc's form to "a grindstone with a sharp edge, instead of a flat rim." I have called it, in popular language, a sharp-edged disc, being in reality two equal frusta of equal and similar cones (cut at right angles to the axis), united at their bases—the major axis of the disc about double the minor, on which it rotates. The wider the disc the better, so that it produces little or no vacuum in its rear during flight. To give the powder-chamber strength it was made cylindrical, of the same width as the minor axis of the disc, and only of a length designed to receive the charge. As a rule its size and form would depend upon the nature of the charge. The catch was a projection of steel fixed in the interior of the muzzle (or short barrel) exactly where, the disc being rolled home, a perpendicular line through the centre would touch the bottom. A notch cut in the periphery of the disc locked on this catch. Its strength was not severely taxed—it received no blow—the disc only pressed hard against it just before it started with its smooth rolling motion. Though the gun was so short that the extremity of the muzzle aloigned with the outside edge of the disc when pressed home, experiment showed that its shortness did not affect precision. The last few inches at the muzzle, in every description of gun, become the final guide. A small bend close to the muzzle causes a divergence of the shot that continues a constant quantity in every round. With good fitting the disc could not swerve from any of the six nearly equal sides that governed its direction. Nor did the shortness of the gun prevent a good aim, for the sights were far apart. As it performed well when so curiously shot, it was certain to answer better when longer, within certain limits dependent upon the nature of the powder. It was evident the muzzle (barrel) could be so lengthened as to be adapted for porthole duty (as stated in a paper I read in February, 1867, at the United Service Institution), yet be conveniently loaded. The exact distance from the catch to the extremity of the muzzle was set off on the periphery of the disc from its notch. The mark made there should always touch the edge of the muzzle before the disc was rolled in vertically. From its smooth, easy roll it could be pushed home with a slight thrust, on the muzzle (or short barrel) being a little elevated, and would lock firmly on the catch (or catches). Should there be any mistake, it would roll out on the breech end being raised. The worst that could happen would be a failure in precision and velocity. As there is windage there could be no jamb. It should also be borne in mind that merely one revolution of the disc covers more than three times the length of its major axis, therefore that lengthening it by making it a breechloader would seem unecessary; but were it required it could easily be effected. Say that it is to be yet further lengthened by three and a half times a major axis of the disc, the trunnions of the part to be added (fixed near the centre) would be borne, almost balanced, on supports from the trunnioned bed. The inner end would be shaped in the outward curve described by arcs, the radii of each (nearly twice a major axis of the disc) meeting in the straight line that would connect the centres of the trunnions. The end of the muzzle of the fixed part of the gun would be formed in a corresponding inward curve to receive the outward curve of the movable part.

In loading, the curved end of the added part would be depressed through an opening in the trunnioned bed to about 45 deg. to allow room for the disc being rolled into position. Two short light-bars, fixed on the upper surface of the added part, would act as a guide to the disc.

About three and a-half times a major axis of the disc is suggested as about the least length for the added part, in order that room should be afforded for conveniently inserting the disc. On that part resuming its normal position there would be no strain, when the gun was fired, on its trunnions in the direction of the gun's axis, tending to force asunder the function of the two parts, for there is no rifling. Although there is no friction, and the gas and disc escape quickly, should expansion from heat, when firing, militate too strongly against this arrangement, the added part, travelling horizontally on fixed rollers, might be partially telescoped into a collar on the other part. It would probably be worked with a pinion and rack and long arm.

The loss arising from windage would in all cases be compensated for by a calculated addition to the powder, without endangering the gun, as the extra gas would escape through the windage. With a large chamber and even ordinary powder such guns ought to have an immense range. Slow burning powder would never be required, as the disc would so soon leave the barrel.

In order that the disc may be projected in any plane, the gun should turn in a trunnioned bed. Whatever was the external shape of the gun, it would be embraced transversely in the middle by a circular belt, which would travel on friction rollers in a corresponding groove hollowed out of the trunnioned bed. A long bar, shipped when required through a transverse hole in the rear of the breech, would give good leverage for turning the gun. It would be sighted on the top, bottom, and two sides. In attacking armoured decks the rotation of the disc would be that of a backing wheel, in attacking armoured bottoms, that of an advancing wheel. In attaching armoured vertical sides at angles inclined to the right from the line of trajectory, the rotation would be from left to right; *vice versâ* were the armoured vertical sides inclined to the left.

The advantage of the several rotations for the specified occasions becomes manifest by considering the action of a billiard ball as fully explained in a letter headed "Guns and Ironclads" in the *Standard* of the 10th of last September. Struck with a left side stroke against the cushion to the left, much of the force of the stroke is absorbed by the cushion—the more the side given to the ball the more the absorption. Similarly with a disc projected with backward rotation against a ship's deck, much of its energy would be absorbed by the deck—the greater the rotation the greater the absorption, therefore the greater the injury inflicted. With contrary rotation the disc would bound off on touching the deck, but did it strike the ship's bottom, it would receive an impulse upwards that would send it crashing through any double casing or cellular compartments. Should it strike the water, though it would not bound off, it appears reasonable to think it would receive an impulse upwards that would make it travel horizontally, and its shape, assisted by rapid rotation, would make it travel far, comparatively speaking, without deviating from the line of aim. It seems probable that a turbot-shaped vessel would be attacked below her fins rather than above them, as she would there present by far the larger target. In old days shots on ricocheting at sea have occasionally been found to do much mischief to an enemy—the disc projected horizontally would make capital "ducks and drakes." If, projected with backward vertical rotation, it pierced the wooden side of a ship like the *Italia*, it would be deflected downwards through her deck.

The powder charge, separate from the disc, and carried in a hollow cylinder within a light cradle fitted to the interior of the barrel, would be pushed into the chamber by a piston. Should science never succeed in so toning down the action of dynamite or guncotton, in guns of large calibre, that neither substance could be used, the disc ought to be retained within the barrel a sufficient time to enable an ordinary charge to exert its full expelling force. Instead of one catch at the bottom, there would be two fixed higher up, one on each side of the sloping faces of the barrel, with corresponding notches to receive them on the sloping faces of the disc. The higher the catches the greater would be the force exerted to give rotation, the greater would be the rotation; and the greater the rotation, the greater the resistance to deflection in flight, as exemplified by the action of the gyroscope. When a coachman washing his carriage wheel spins it round, the nearer to the axle is the pressure of his hand the greater will be the spin, but the greater must be the force applied. With catches fixed too high the gun would burst before the disc was expelled. For natural rotation, as it might be termed, viz., when the circumferential velocity equals the velocity of translation (about 22 to 7) the higher the catches the nearer should they be to the powder chamber. Assuming the disc to be pressed home and to stand vertically, it will be found that when the upper surfaces of the catches are 5-28ths of a major axis above the horizontal plane of the bottom of the muzzle, their lower edges should be a similar distance in a horizontal plane from the vertical plane passing through the minor axis of the disc. That distance would have a less and less ratio to the height, as that height had a decreasing proportion to a major axis. This arrangement would bring the nick to lock on the catch when about midway in the descending part of its circuit. The nearer the catches are to the vertical minor axis-plane, the more rapid would be the rotation and the greater the tendency to start with the eccentric rotation prevented by the sloping guiding surfaces in the muzzle. The rotation might be yet further increased by slightly scoring the bottom of the barrel.

Rotation far beyond what is necessary to secure stability in flight —a rotation really amounting to a rapid spin—would in this easy manner be effected strictly in accordance with the mechanical law which directs that the objects sought should be obtained by the least possible expenditure of means, and in the simplest way—whereas the rotation acquired by rifling is in direct violation of that law—rotation is its only gain; all its other effects are injurious. Much extra powder is necessarily used to give velocity, combined with rotation through spiral grooves, to a ponderous bolt, causing strain, friction, heat, and wear. Moreover, the gas acts on only a small surface of a cylindrical projectile, one equal to its transverse area; whereas with the disc it would act, weight of projectiles being alike, on a far larger surface, one computed as equal to a section through its minor axis, and as the six sides forming the interior of the barrel are perfectly smooth, the disc would come forth the instant it was forced over the catches, with unusual initial velocity. The fact that it would roll out offering no resistance to expulsion shows also that it would have comparatively little recoil, for there will be none of the ordinary long-continued action within the barrel of a slowly-receding gun driven backwards from its rapidly advancing shot, whereby recoil commences before the shot makes its exit. Action and reaction are doubtless alike, but the reaction on the moving power, from inert masses of similar weight put in motion by the said moving power, may be very different. No one will think that the reaction from starting an upright wheel is the same as the reaction from starting the same wheel when it is lying flat on the ground.

From the disc's sharp edge, smooth surfaces, cleaving action through the air, and little or no vacuum in its rear, is it not reasonable to suppose that it would have long sustained velocity? As horizontal progression through space would cease before circumferential velocity was much affected, the disc on sinking to the ground would start with renewed progressive velocity. With vertical rotation—which would be the usual rotation—should the disc be projected in a plane not truly vertical, the pressure of a side wind would tend to bring it to an upright position.

Converted into a mortar the gun ought to have unusual precision, and unusual penetration, as whenever it fell it would strike with a sharp edge. Against such a projectile it would be difficult to make any buildings bomb-proof, and where it failed in penetrating it might effect much mischief in its spinning run.

From the disc's vertical rotation it is obvious that it would be admirably adapted for sweeping parapets. It could be made a *projected* mitrailleur, effective at an immense distance, discharging its bolts with a horizontal trajectory, without destroying its efficiency as a rapidly rolling shot. It could be composed of many laminæ loosely hung on an axle (coned from the centre) which, separating during their vertical flight, and whirling rapidly along the ground, would prove most destructive to cavalry or infantry. Of course it could be made a large shell—an immense shell if the little weight of the gun be considered.

Short light guns mean little strain to narrow platforms, and suggest the erection of small, light, yet formidable forts at the end of breakwaters, and in positions where heavier structures would not find a sufficiently stable foundation. These guns being too short to become heated can be fired as fast as loaded, and thus be made to do the work of nearly double the number of the ordinary type. They would prove useful in arming our merchant steamers for offence as well as defence at the outbreak of a war; would not occupy much space, nor strain the smaller vessels, and would be so handy that any crew could soon learn to work them efficiently.

Were the proposed means of obtaining rotation ever carried out with small-arms, as the recoil would be less than usual, convenient wall-pieces could be constructed that would penetrate the thickest sap rollers; and, should the difficulties attendant on making a light breechloader be overcome, an arm could be put into the hands of our soldiers discharging projectiles that would penetrate the best designed helmets that could be invented, but, what is of far more consequence, that would, as a rule, in firing low during a fog or smoke, on striking the ground, bound from spot to spot as long as any spin existed.

Could small vessels of the turbot form be made safe sea boats, assuming the experiments at glance-targets, concluded last August, to have really shown, as reported, that "at angles of 30° to 60° an ordinary armour-plated ship can resist the penetration of shot," it is but too evident that our best ironclads, armed as they now are, might be approached with impunity within destroying distance by a torpedo-vessel, whose armoured deck and bottom were inclined at less than the named angles from a horizontal plane. Network hung on struts projecting from the turtle-shaped torpedo-vessel's widely extended over-hang, would effectually protect her from opposing torpedoes, while similar defensive nets could not be suspended at a sufficient distance from the flat sides of long ironclads to be of much service. Moreover, the recent great advances made in metallurgy, the various properties now known to be possessed by different kinds of steel, and the gain attendant of uniting steel plates to a backing of iron, show that the deflecting power of horizontal armour may be yet further increased, but, fortunately, they also show that the projectiles may be rendered so malleable, yet hard, as not to break up on striking.[*] In a leader of the *Standard* it has been aptly said that "deflection rather than direct resistance" will be "the motto of the naval architect defending the vital parts of his ship against the flying bolts of modern artillery"; but happily for us, however great may be the improvement made in the defensive form given to torpedo vessels, and in the initial velocity imparted to torpedoes by Captain Ericcson and others, the resistance of water will ever prevent their travelling far; therefore, to prove effective, the vessel carrying them must get near her enemy, and to do so, she need not have great speed unless we suppose the giant obliged to run away from the dwarf; but it will be surprising if in these scientific days some sort of weapon (or gun completely differing from the type in use) be not invented that will destroy horizontally armoured torpedo vessels before they can get within striking range. Our existence as a commercial nation depends upon it, and in the race of nations, unless we have commerce, we are nowhere. I hope the vast importance of the matters discussed will successfully plead my apology for this long letter. The introduction of armoured turbots leads to the retirement of spirally-rifled ordnance, and some substitute must be found for much of the magnificent artillery on which we have hitherto confidently relied. Should I not have suggested a step in the right path I hope I have aroused the attention of those more competent than myself to perceive in sufficient time as clearly as I do the frightful position in which we may be placed should we fail in obtaining a means of penetrating what has been called "horizontal armour."

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[*] The *rapid* rotation of an advancing wheel given to discs tends to their preservation on striking vertical armour, or horizontal armour on a ship's bottom. The force of reaction is received in two directions—in the direction of the line of trajectory, and in the line of rotation—which makes the violence of the shock less than more it received in only one direction.

Were the circumference of the discs hardened, or faced with steel, the same law would befriend them that makes armour plates possessing steel faces united to a backing of iron nearly invulnerable.

LAUNCHES AND TRIAL TRIPS.

We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Blowden.—On the 30th November, there was launched from the yard of the Sunderland Shipbuilding Company (Limited), South Dock, an iron screw steamer, built to the order of the Arvon Shipping Company (Limited), of Caernarvon. This vessel, which is the seventh launched from this yard for the same company, is of about the following dimensions:—260 ft. long, 34 ft. broad, and 18 ft. 9 in. depth or hold, rigged as a two-masted schooner, with full poop, raised quarter deck, bridge, and topgallant forecastle, water-ballast iron decks, fore-and-aft bulkheads, as well as five water-tight bulkheads, for the better stowage of grain cargoes, four powerful steam winches, Harfield's windlass, steering-gear both aft and amidships, and all the most approved appliances for working the vessel with the quickest despatch in loading and discharging, and is built in the most substantial manner under special survey to take the highest class. The engines which are built by John Dickinson, Esq., of Sunderland, will embrace the latest improvements for economical working, and are of 160 nominal horse-power. The vessel on leaving the ways was gracefully named the *Blowden* by Miss Horsley.

Granville.—On the 1st December there was launched from the yard of Messrs. Raylton Dixon & Co., of Middlesbrough, a steamer named the *Granville*, built to the order of Henry Pease, Esq., of Darlington, and intended for the Spanish ore trade, being almost a duplicate of the *Congress* (s), which was built by Messrs. Dixon for the same Owner, about a year and a half ago. Her length is 250 ft., breadth 34 ft., depth of hold 16 ft. She will carry over 1,600 tons on 16 ft. draught. She has iron main and quarter decks, and a hood aft for the protection of the steering gear; her cabins are placed amidships under the bridge; she has water ballast in both holds, three horizontal steam winches, and other convenience. She will have engines of 130 horse power, which are being constructed by Messrs. Blair & Co. (Limited), of Stockton. She was christened the *Granville* by Miss Pease, daughter of the Owner.

Charles Attwood.—On the 1st December there was launched from the Tyne General Ferry Company's Yard; at St. Peter's Quay, a new river steamer intended for the passenger traffic on the Tyne. The dimensions are:—Length, 106 ft. breadth, 15 ft. and depth, 7 ft. 68 gross and 44 net register tonnage. She will be fitted with a pair of oscillating conednsing engines of 30 nominal horse-power cylinders, 22 in. diameter, and 26 stroke, a multitubular boiler with all the latest improvements. The hull, boiler and machinery are constructed of mild steel, manufactured by the Weardale Company, at Tudhoe, and the Stanners Close Steel Works, Wolsingham. As the vessel left the ways she was named the *Charles Attwood* by Master William Rogerson, of Croxdale Hall, Durham.

Accretive.—On the 2nd December there was launched from the yard of Messrs. S. P. Austin & Son, Sunderland, a new steamer of about 1,600 tons deadweight, arranged with every recent improvement, suitable for general trades. This steamer has been built to the order of Messrs. Coatsworth, Stockdale & Co, of Sunderland. As she left the ways she was christened the *Accretive*, by Mrs. Cuthbert Hutchinson, of Rock Lodge, Monkwearmouth.

Hardwick.—On the 2nd December Messrs. Edward Withy & Co. launched from Middleton ship yard, West Hartlepool, an iron screw steamer, built to the order of Messrs. R. Ropner & Co., of West Hartlepool. Her principal dimensions are:—Length, B.P., 235 ft. 6 in.; beam, extreme, 31 ft. 6 in.; depth, moulded, 15 ft. 8 in. She is built to Lloyd's highest class, and has topgallant forecastle, bridgehouse, and long quarter deck, double bottom, all fore and aft on the cellular principle, has iron decks, charthouse, engine and cabin skylights, and cabin companion. She will be fitted with engines of 100 nominl horse-power, by Messrs. T. Richardson & Sons, of Hartlepool Ironworks. As she left the ways she was christened *Hardwick*, by Miss Helena Jachmann, of Wurzburg.

Homer.—On December 3, a large screw steamer, named the *Homer*, was launched from Messrs. Readhead & Sons' shipbuilding-yard at South Shields. She is classed 100 A 1 at Lloyd's, and was built for Messrs. Dick & Page, of London, for the Mediterranean and general trades.

Endymion.—On December 8 there was launched from Palmer's shipyard, at Jarrow, an iron screw steamer, built to the order of Messrs. Hall Bros., of Newcastle, and as the vessel left the ways she was named the *Endymion*, by Miss M. G. Armstrong, daughter of Mr. Robert Armstrong, shipyard manager. The vessel will be engined by the Palmer Company with high powered compound engines, and will be fitted and equipped with all modern improvements. She has been built specially for the Atlantic and general trades, and will carry about 3,200 tons.

Beignon.—On December 15, an iron screw steamer, called the *Beignon*, was launched from Messrs. Richardson, Duck, & Co.'s shipyard, at South Stockton. The vessel's gross tonnage by new measurement is 1,258 tons, and her engines, built by Messrs. Blair & Co., are of 120-horse power nominal. The *Beignon* has been built for a Cardiff firm, and is intended for general ocean trading.

Libelle.—On December 16, an iron screw steamer, named the *Libelle*, was launched from the shipbuilding-yard of Messrs. Schlesinger, Davis, & Co., at Wallsend. The *Libelle* has been built for Mr. O. L. Eichmann, of Hamburg, and her leading dimensions are:—Length between perpendiculars, 243 ft.; breadth, 33 ft.; and depth, 19 ft. 6½in. The christening ceremony was performed by Master James Wood. This is the sixth vessel Messrs. Schlesinger, Davis, & Co. have built for Mr. Eichmann.

St. Pauli.—On December 18 Messrs. Short Brothers launched from their shipbuilding-yard at Pallion, Sunderland, a screw steamer, built to the order of Mr. J. H. Lorentzen, of Hamburg, making the twenty-third steamer Messrs. Short Brothers have built in which Mr. Lorentzen has an interest. This vessel, which is intended for the general trades, is of the following dimensions:—Length between perpendiculars, 260 ft.; breadth, 37 ft.; and 15 ft. 9 in. depth of hold, with a deadweight carrying capacity of about 2,150 tons. The vessel is built on the cellular principle, having water ballast tanks all fore and aft, and as these are carried very high up in the ends of the vessel, she will have a better hold of the water when light than is usual; there are six watertight bulkheads and a laid 'tween decks, Price's patent hatches, four steam winches, and a Blake's patent donkey boiler will be fitted. The engines are 150 nominal horse power by Mr. John Dickinson, of Sunderland, and the main and crank pin brasses and other important bearings are all of phosphor bronze, cylinders 33 in. and 62 in. by 36 in. stroke, two large three furnace boilers, working pressure 80 lbs. The vessel is built in excess of the highest class in Liverpool Lloyd's, and is also to the German Board of Trade requirements, built under the superintendence of Mr. Joseph R. Oldham. On leaving the ways she was named the *St. Pauli*, the ceremony of christening being performed by Miss Reay, of the Cedars, Sunderland.

Easington.—On December 18 Messrs. W. Gray & Company launched from their yard at West Hartlepool a steamer, built to the order of Messrs. G. T. Pearson & Company, of West Hartlepool. She is sister ship to another building at Messrs, Gray's for the same Owners, and the pioneer of a numerous fleet. Her dimensions are :—Length, 256 ft. 6 in. ; breadth, 34 ft. 6 in. ; and depth of holds, 19 ft. 8 in. and 24 ft. ; classed 100 A 1, the highest class at Lloyd's ; engines 150-horse power, by Blair & Company, Stockton-on-Tees ; will carry a deadweight of 2,350 tons, and is designed for the American and Indian trades. As she left the ways she was christened the *Easington* by Mrs. Pearson, of Castle Eden.

Cardiff.—On the 18th Dec., Messrs. Doxford & Son launche from their shipbuilding-yard at Pallion, Sunderland, a steamer named the *Cardiff* (*pro tem.*) by Miss Carr, of Dublin. The vessel is 240 ft. long, 35 ft. broad, and 16 ft. deep, her gross tonnage being 1,600. She is intended for the coasting and continental trades, and will be fitted with everything necessary for working both ship and cargo. The engines will be fitted at Messrs. Doxford's works. The cylinders will be respectively 31 inches and 56 inches, with a stroke of 36 inches. The vessel will be classed 100 A 1 at Lloyd's.

Yan Ylan.—On December 18th, in the prenence sf a large number of persons, was launched from the works of Edward Finch & Co. (Limited) an iron screw steamer to carry about 200 tons dead weight ; length, 100 ft. ; breadth, 18 ft. 9 in. ; depth, 8 ft. 9 in. ; the engines are compound surface condensing, with multitubular boiler. There were present at the launch, which was a most successful one, the owners, Messrs. Osborn & Wallis, of Cardiff, and Mr. James Rowe, manager of the works. The vessel as she glided into the water, was christened the *Yan Ylan* by Miss Rowe, the daughter of the manager. This is the third ship launched by this firm in the present year.

Gainsborough.—On December 20 Messrs. Earle's Shipbuilding and Engineering Company launched from their yard at Hull, a steamship named the *Gainsborough*, for the Manchester, Sheffield, and Lincolnshire Railway Company. The vessel was taken in tow, and placed in Messrs. Earle's private dock, where she will receive her machinery. The *Gainsborough* is intended to ply between Grimsby and Hamburg. She is 231 ft. in lenght, 30 ft. 6 in. beam, and 17 ft. depth of hold ; gross tonnage, 1,100 tons ; long poop fitted with saloon and state rooms for 40 first-class passengers topgallantforecastle for Seamen and Firemen, also accommodation for emigrants in 'tween decks. She is to be fitted with engines of 900 indicated horse-power, also built by Earle's Company, having cylinders of 32-inch and 62-inch diameter, and 36-inch stroke ; one large double-ended boiler with total heating surface of 2,609 square ft., working pressure 70 lbs. The speed of the *Gainsborough* is intended to exceed that of any ship at present on the line. Besides the *Gainsborough*, there are building at these works two New York steamers for Messrs. T. Wilson, Sons & Co., of Hull ; one Baltic and one Gothenburg mail and passenger steamers for the same Owners ; one New York liner for Messrs. Rankin and Gilmour, of Liverpool, and two steamers are about to be laid down for Lisbon Owners. All of these steamers will be enginged by Earle's Company.

LAUNCHES.—SCOTCH.

Advance.—On the 1st December Messrs. Robert Duncan & Co. launched from their yard at Port Glasgow an iron screw steamer named the *Advance*, of the following dimensions :—Length, 245 ft. ; breadth of beam, 34 ft. ; depth of hold, 18 ft. 6 in. The *Advance* has been built for Messrs. Thomson & Co., of Cardiff, to the order of Messrs. Rankin & Blackmore, engineers, Greenock, who will supply the new steamer with engines of 170-horse power.

Fiume.—On the 1st December there was launched from the shipbuilding-yard of Messrs. H. M'Intyre and Co., Merksworth, Paisley, an iron screw steamer of 1,650 tons burthen, built to the order of Messrs. Burrell & Son, Glasgow, and intended for the Adriatic trade. The steamer's dimensions are 245 ft. long by 32 ft. broad by 19 ft. deep. She is built on the double-bottom principle, and is fitted with all modern improvements. She will be engined by Messrs. Jas. S. Hume & Co., engineers, Portman-street, Kinning Park, Glasgow. As the vessel left the ways she was christened the *Fiume* by Miss Mary Burrell, the youngest daughter of the managing owner.

Wycliffe.—On December 2 there was launched from Messrs. Ramage and Ferguson's shipbuilding-yard at Leith an iron screw steamer, of 1,300 tons burthen, for the China coasting trade. As she left the ways she was named the *Wycliffe* by Miss Eggers, of Summerside, Leith, and afterwards towed round to the Albert Dock to receive her machinery. The *Wycliffe* has been built to the order of the Wycliffe Steamship Company (Limited), of which Messrs. Huntley, Berner, & Co., West Hartlepool, are the managing owners, and is the pioneer vessel of their new line in the East. She will be commanded by Captain Paul Bernard. This is the tenth steamer launched by Messrs. Ramage & Ferguson, at Leith, this year, and they have at present eight vessels on the stocks, four of which are for China.

Rhenania.—On December 2 Messrs. Dobie & Co. launched from the Govan shipbuilding-yard an iron screw steamer, built to highest class, and measuring 1,900 tons. As she left the ways the vessel was named the *Rhenania* by Miss Florence Roberts, of Gibraltar. The builders have under construction two other similar vessels for the same owners, the Hamburg-American Company. Messrs. James Howden & Co., engineers, are supplying the machinery for these steamers.

Nereus.—On December 3 Messrs. Robert Duncan & Co. launched, at Port Glasgow, a full-rigged iron ship of the following dimensions.—Length, 225 ft. ; breadth of beam, 37 ft. ; depth of hold, 22 ft. ; and 1,270 tons register. This ship, which is named the *Nereus*, has been built for Mr. Colin S. Caird, Greenock, and is sister ship to the *Narcissus*, built by Messrs. Duncan & Co., three years ago. The *Nereus* is for the East Iudia trade.

Romeo.—On December 4 Messrs. Murdoch & Murray launched from their building-yard at Port Glasgow, an iron screw steamer named *Romeo*, of the following dimensions :—155 feet by 22 feet by 12 for his Excellency the Marquis De Campo, intended for the Manilla trade as a feeder for his line of Spanish Royal Mail steamers. The steamer is fitted in an elegant style, for about 20 first-class passengers, and is intended to carry 480 tons deadweight. She will be fitted with compound surface-condensing engines made by Messrs. Muir & Houston, of Glasgow, capable of driving her 10 knots per hour. The ceremony of naming was performed by Miss Saberon, of Liverpool.

Mandarin.—On the 10th December Messrs. H. M'Intyre & Co. launched from their shipbuilding-yard at Merksworth, Paisley, the *Mandarin*, an iron screw steamer of 850 tons, built to the order of a Glasgow firm for the China trade. The *Mandarin*, which is built to the highest class at Lloyd's, under special survey, and fitted with all the most modern improvements, will be engined by Messrs. Hutson & Corbett, Glasgow.

Sanitre.—On December 16th there was launched from the shipbuilding yard of Messrs. Dobson and Charles, Grangemouth, a screw-steamer named the *Sanitre*, of 300 tons, and the following dimensions :—135 ft. by 26 ft. by 8½ ft. She is intended for the Bombay passenger trade, and will be fitted with compound engines of 45-horse power by Messrs. Dunsmuir and Jackson, Glasgow.

Garth Castle.—On the 16th December, Messrs. John Elder and Co. launched from their yard at Govan another addition to the fine fleet of steamers carrying the flag of Messrs. Donald Currie & Co. between this country and the Cape of Good Hope. The ceremony of naming the new ship the *Garth Castle* was performed by Miss Elsie Currie, daughter of Mr. James Currie, of Leith. The principal dimensions of the vessel are :—Length, 376 ft. ; breadth, 43 ft. 6 ins. ; depth, 32 ft, 9 ins. ; tonnage, 3,800 (gross). She will be supplied by the builders with a set of compound engines, with inverted cylinders, the high pressure 51 ins. and the low pressure 88 ins by 4 ft. 9 ins. stroke, steam to be supplied at 75 lbs pressure from two cylindrical boilers, and the engines will indicate about 3,200-horse power. She is named the *Garth Castle*, after the ancient keep or fortalice of that designation, purchased, with the Garth estate, by Mr. Donald Currie, M.P., a few months ago. The hull of the *Garth Castle* is divided into nine water-tight compartments, the divisions being carried to the upper decks, and in four of the bulkheads there are sliding watertight and fire-proof doors. By this arrangement there is no danger in the event of fire breaking out in any division of the ship, and the special care in providing for the safety of the lives on board entitles the vessel to be entered on the Admiralty List as a first-class transport. In the first-class accommodation there will be berths for 166 passengers, in the second cabin berths for 130, and the steerage will be planned for 100. The *Garth Castle* will be brig-rigged, and the masts and yards are to be of steel. Watertank space for several hundred tons weight is provided, in order to secure regularity of trim on the passage to and from the Cape. The vessel is to be steered by steam steering wheels being placed on the upper bridge or promenade deck, while additional steering gear is provided at the stern, with a view to greater safety. She is classed in the highest grade at

Lloyd's. In a special manner the *Garth Castle* is fitted, like the other ships of the fleet, for war purposes, the three decks being of iron and sufficiently strong to bear heavy guns. This is the eighteenth vessel of Messrs. Donald Currie & Co.'s Cape and Natal mail fleet, which now amounts to a tonnage of about 40,000.

Egyptian Monarch.—On December 18th the steamship *Egyptian Monarch*, built for the Royal Exchange Shipping Company, London, managed by Messrs. John Patton, jun. & Co., Cornhill, E.C., was launched from the dockyard, Dumbarton. The *Egyptian Monarch* is the second of three similar vessels built and building by Messrs. M'Millan for this firm, two of them, including the vessel just launched, being of iron and one of steel, and being intended for the new Monarch Line, to trade from London to New York, carrying first-class passengers, emigrants, cattle, faesh meat, and general cargo. The principal dimensions are as follow:—Length, 370 ft.; breadth, 43 ft.; depth, 35 ft. 9 ins.; tonnage, gross, including shelter deck space, about 4,000 tons. The engines, made by Mr. David Rowan, Glasgow, are compound double cylinder, inverted, direct acting, of 2,800-horse power. The steamer has a continuous double bottom constructed on the bricket and longitudinal girder system, divided into compartments, and available for water ballast to the extent of 600 tons; and she has four decks, two being of iron sheathed with wood, and the top or shelter deck is of teak.

Mount Hermon.—On the 20th December, Messrs. Alex Stephen & Sons launched at Glasgow an iron screw steamer of about 2,500 tons, classed 100 A 1 at Lloyd's under special survey, and built to the order of John Smith, Esq., Glasgow. The vessel, which has accommodation for a limited number of first-class passengers, embraces all the most approved appliances for loading and discharging cargo, and is constructed with provision for water ballast in a double bottom on bracket principle throughout. Her engines, which were fitted on board before launching, are of 240-horse power nominal, having cylinders 38 in. and 68 in. diameter by 45 in. stroke, with boilers of ample capacity, suitable for 85 lbs. pressure, and are of the most improved modern type. Miss Allan, Edinburgh, performed the ceremony of naming the vessel *Mount Hermon*. The Messrs. Stephen have a sister steamer well advanced for the same owner.

Macapa.—On the 21st December there was launched from the building-yard of Messrs. Blackwood and Gordon, Port Glasgow, a twin screw steamer named the *Macapa*, built to the order of the Amazon Steam River Navigation Company. The following are her dimensions—190 by 28 by 10, and about 500 tons. She will be supplied by her builders with twin-screw engines of 120 collective horse power, and be provided with accommodation for 60 first-class passengers. She will be employed in passenger traffic on the river Amazon and its tributaries. This is the second steamer of similar proportions built by Messrs. Blackwood & Gordon within the last four months for this firm for the same traffic.

Roumania.—On December 22 there was launched from the shipbuilding-yard of Messrs. David & William Henderson & Co., Meadowside, Partick, an iron screw steamer for Messrs. Henderson Brothers, of the following dimensions:—Length, 364 ft.; breadth, 38 ft.; depth, 28 ft. 6 in.; gross tonnage, 3,380 tons. She will be supplied by her builders with compound engines of 500-horse power. As she left the ways the vessel was named the *Roumania* by Mrs. W. F. G. Anderson. The *Roumania* will have accommodation on upper deck for 40 first-class passengers, and she is intended for the Anchor Line Indian service between Glasgow, Liverpool, Bombay, and Kurrachee.

TRIAL TRIPS.

Joshua Nicholson.—On the 29th November, the new screw steamer *Joshua Nicholson*, belonging to Messrs. Tully, Wallace & Co., Newcastle, left Shields for her trial trip to sea. This vessel was recently built at Willington by the Tyne Iron Shipbuilding Company, and was afterwards engined by Messrs. R. &. W. Hawthorn, of Newcastle. Her dimensions are 270 ft. in length, 35 ft. beam, and 24 ft. 6in. in depth of hold, and her dead weight capacity is 2,800 tons. Her engines are 160-horse power. She has been built for Lloyd's classification 100 A 1, and is fitted with the most recent improvements for despatch and economic working. She made 11 knots on her trial trip.

Marana.—This vessel, lately, launched by Messrs. Aitken & Mansel for Messrs. Geo. Bell & Co., Liverpool, left Queen's Dock or Gareloch for adjustment of compasses and trial trip at Wemyss Bay. The *Marana* has compound engines of 220 nominal horsepower, by Messrs. John & James Thompson, and after the trial trip left for Southampton.

Brindisi.—On the 4th December the new steamship *Brindisi*, built for the Peninsular and Oriental Company, left the South Dock, Sunderland, on her trial trip. The *Brindisi* was launched from the yard of Messrs. Doxford & Sons, Pallion, about three months ago, and has since been engined by the same firm and fitted out. She is 360 ft. in length, her breadth is 36 ft., her depth of hold 32 ft., and her nett tonnage (registered) 2,261. She has three decks—the upper or spar deck, the main deck, and the lower deck. The spar deck is of wood and iron, and upon it are a forecastle, two deckhouses, and other erections. The forecastle is a comfortable wooden house fitted up for a large number of the Firemen, Coal Trimmers, and Seamen, all of whom are Lascars, and in addition there is a cook-house for the Crew. The main saloon is 36 ft. wide and 18 ft. long, and the fore-and-aft saloon is 80 ft. long. In the aft of the spar deck is situate a house 48 ft. long by 18 ft. wide, in which a music saloon is fitted up. The vessel has accommodation for about 100 first-class passengers. The engines are on the most approved principle, of 600-horse power, and there are seven boilers, each having three furnaces, as well as a donkey boiler. The masts are of iron; they are three in number, the vessel being rigged as a three-masted schooner. The vessel will be in charge of Commander Lee.

Montgomeryshire.—On the 13th December this screw steamer, which has just been finished by Messrs. Raylton, Dixon & Co., of Middlesbrough, to the order of D. J. Jenkins, Esq., M.P., for Falmouth, for his of line steamers to China, proceeded to sea on her trial trip. The *Montgomeryshire* is a boat of 280 ft. in length by 35 ft. beam, and 24 ft. 6 in. depth of hold, and will carry about 2,800 tons of deadweight cargo. She has a full poop and forecastle, the former of which contains the cabin accommodation, the Officers and Engineers being located under the bridge, and the Crew in the forecastle. The Cabins are arranged for 16 passengers. The front of the poop, bridge, and forecastle are of iron, panelled with teak. Patent steam steering gear by Muir & Caldwell, of Glasgow, is placed in the steering-house on the bridge, and she is fitted with patent compasses and sounding gear by Sir. Wm. Thompson. Her engines of 250-horse power, by Messrs. Thomas Richardson & Sons, of Hartlepool, are also fitted with the latest improvements, and gave very satisfactory results on the trial trip.

Dowlais.—On December 15th, the *Dowlais* (s), built and engined at Messrs. Palmers, at Jarrow, for Messrs. Mosel, Brothers, & Co., of Cardiff, had her trial trip to sea. After leaving the Tyne she was tried across the measured mile, when a mean speed of 10 knots per hour was obtained. The *Dowlais* is 240 ft. long, 33 ft. in breadth, and her depth of hold is 16 ft; her engines are of 99 horse-power, and her registered tonnage is 762.-68 tons. She is fitted with all the latest improvements, including Nelson's steam steering gear.

Redstart.—On the 16th December, the new screw steamer *Redstart*, built to the order of the General Steam Navigation Company, London, by Messrs. M. Pearse & Co., of Stockton-on-Tees, had her trial trip. The vessel is 220 ft. in length by 31 ft. beam, and 16 ft. 6 in. depth of hold, with a carrying capacity of fully 1,300 tons. She has been built under special survey, and classed 100 A 1 al Lloyd's. In addition to her ordinary cargo space she is fitted for carrying a large number of cattle. The *Redstart's* engines are by Blair & Co., of Stockton, being on the compound surface condensing principle, and 110 horse-power nominal. At an early hour in the morning the steamer left the establishment of the builders and proceeded into the Tees Bay, where her compasses were adjusted. At the conclusion of the adjustment a trial of speed was made, and in the midst of a heavy sea and squally weather she steamed over 11 knots, the engines and all connected with her working admirably, the trip proving satisfactory in every way. On entering the Tees a run was made over three measured miles, the time being a trifle over four minutes per mile, the engines working up to 80 revolutions per minute. The steamer was shortly afterwards moored at Middlesbrough to await orders as to her destination, when she will sail under the command of Captain Taylor, one of the Company's Masters.

The first trial of a torpedo boat under the new condition of a three-hours' continuous full-power trial was made Dec. 20 in the Solent. Mr. John Oliver being on board to represent the Admiralty. The boat was a second class Thornycroft, known as 68. Ten runs were made on the measured mile. The mean results showed a speed of 16 knots, being considerably beyond the contract.

Cataluna.—On December 22nd, the new screw steamer *Cataluna* recently launched from Messrs. Hodgson & Soulsby's iron shipbuilding-yard at Cowpen Quay, Blyth, performed her trial trip. The steamer is constructed on the latest improved principles, being fitted with all appliances to secure expedition, and is of the following dimensions:—Length 220 ft; breadth, 30 ft; depth, 18 ft. 6 in. She is classed 100 A 1 at Lloyd's, and has been built under special survey. After taking in bunker coals the steamer left Blyth Harbour in the forenoon. The steamer has been engined by Messrs. Black, Hawthorn & Co., of Gateshead, and the machinery worked most smoothly, the vessel having obtained a speed of 11 knots an hour. The steamer is fitted with two iron decks, with full length cabin aft for passengers and long bridge for Officers and Engineers, and topgallant forecastle for Crew. The steamer is intended for the wine trade between Cette and Spain. After her trial had been run, the vessel was taken to Tyne Dock to load for Marseilles.

Reviews.

Materials and Construction. By FRANCIS CAMPIN, C.E Weale's Rudimentary Series.

THAT this treatise forms one of Weale's well-known series is a guarantee for its being useful, practical, and comprehensive. It deals with a variety of subjects in which many besides the practical engineer, architect, or builder may find both interest and instruction. Starting from first principles, the writer conducts the reader gradually and logically onwards to the most complicated constructions, explaining principles intelligbly and adding many pieces of sound practical advice. We consider some of his explanations very happy as modes of presentation to the unscientific mind. For instance, he thus describes friction:—"On account of the elasticity of matter, it follows that if a body rest upon another of larger surface than its surface of contact, it will to some extent sink into it, compressing the parts immediately beneath; hence, if the upper body be pushed along, it must, as it were, be pushed into a *higher part*, which, in its turn, sinks under the weight imposed upon it, so that virtually, in moving the upper body, we are constantly pushing it uphill. As time is required for a substance to be compressed, it is evident that if the upper body be moved rapidly upon the lower, it will not at any time sink as much as if it were allowed to rest on one spot, hence the friction at starting, which is the friction of rest, is greater than the friction of motion, and the friction of slow motion will be greater than that of rapid motion, so far as the surfaces themselves are concerned." The explanation of bending compressive and shearing strains may also be referred to as full and clear. Again, as an example of practical advice we may quote from the interesting chapter on "Execution of Work" (p. 235). "A structure standing by its stability having no active duty, faults are not detected so long as it does stand, and under the system of using face-work to a great extent, it is not easy to distinguish between work properly built and that only *heaped up*, after it has been completed; here, then, is a solid reason for keeping an inspector, and one who is both competent and trustworthy, on works during the whole time of their execution. As a striking example of the difficulty of getting work properly done, I will allude to the almost impossibility of getting the ironfounders in many districts to cast columns *vertically*; they will cast them *horizontally*, and of course the core gloats up, and the column turns out with a thick side and a thin one, and unless there is a resident inspector the specification becomes a dead letter and a farce." This latter remark reads with painful interest when taken in connection with the evidence given at the Tay Bridge inquiry. We find practical instruction on such varied subjects as moving heavy ironwork, the method of working stone so as to produce the various beds, tipping banks, forming arches or abutments, testing structures, rivetting chain bridges, &c., &c., in addition to all the usual details as to girders, columns, roofing, and bridge work. A model specification will also be found useful.

Complete Instructions for the Design of Spring and other Safety Valves, also a Table, &c. By THOMAS MESSENGER, C.E., Dover. (Published by the Author.)

This little treatise contains in a convenient form the principal formulæ and tables necessary in valve design and construction, together with some useful hints on general practice. Complete tables are appended for registering all particulars both of design and of working for office use, blank pages being provided for making the corresponding entries. The value of the volume for this purpose is enhanced by its being appropriately printed in folio form on good paper, and strongly bound.

Drawing and Rough Sketching for Marine Engineers. By JAS. DONALDSON. Published by Charles Wilson, 157, Leadenhall-street.

This is the second edition of a very useful little book. Although the quality of its gets up and plates are but rough and ready, and much inferior in general finish to many of the standard engineering works of the kind, it is for this very reason that it probably owes its present success. The finish both of plates and letterpress is amply good enough to impart the desired information, and the consequent cheapness of its production enables the publishers to offer the work at the very modest price of four shillings. This brings it within the reach of all draughtsmen, apprentices, or practical engineers, whereas the usual price of such works varying from one to two or three pounds, renders them quite prohibitive to a large number of intending readers. The subject matter of this book has already been given as embracing drawings and dimensions both of ordinary engine details such as nuts and spanners, shafts, connecting rod ends, valves and cocks, &c., and rising to such designs as a feathering paddle-wheel, a cylindrical marine boiler, and a pair of compound engines. The letterpress accompanying the drawings is clear and practical in its instructions and information, and avoids the frequent error in such books of soaring completely over the readers' heads.

Calvert's Mechanics' Almanack and Workshop Companion for 1881.

This well-known little annual needs but little recommendation from us. It is well up to the standard of former years, and as varied in its combination of instruction and entertainment. It is eminently adapted for its readers—skilled artisans—many large firms taking copies for presentation to their workmen. The present number, in addition to a mass of miscellaneous matter, contains several longer articles, *inter alia*, the Employers' Liability Act, Invention as a Road to Fortune, Notes on Iron and Steel Manufacture, and Practical Rules and Tables for Screw Cutting.

Notes and Novelties.

THE Iron Steamboat Company of New York has closed a contract with the Philadelphia and Chester boat-builders for eight new iron steamers, to be finished May 1, 1881. The amount involved is $1,500,000.

A DEEP SEA SOUNDER.—M. Paul C. Rousset, a Russian engineer, has invented a novel and ingenious deep sea sounder. It consists of an ordinary registering log attached to an inflated balloon, and a lead hung by a trigger at the bottom. This log is lowered into the sea. It sinks in a vertical position; as it sinks the vanes of the indicator revolve, and the depth is correctly registered. When the sinker touches the bottom the trigger sets free the balloon, which rises with the log to the surface and floats until it is picked up.

MECHANICAL REFRIGERATION.—There has lately been completed and tested, with entirely successful results, in the engineering establishment of Messrs. D. & W. Henderson, Glasgow, a Bell-Coleman dry-air refrigerator of the largest dimensions hitherto attempted. The machine is capable of delivering 2,000 cubic feet of air per minute, reduced from a surrounding atmosphere of 80 deg. Fahrenheit to 60 deg. under zero; and in order to obtain the power required to produce that result two huge boilers, measuring each 28 ft. by 7 ft. 6 in., have been made by Messrs Galloway of Manchester. The apparatus has been constructed by the Bell-Coleman Company, to the order of the Government of New South Wales, primarily with the view of storing and preserving the meat supply of Sydney. The daily consumption of meat in that city amounts to 100 tons, and that quantity the engine, it is calculated, will easily reduce to a preserving temperature in the climate of Sydney. The Colonial Government have further in view, in ordering the apparatus, the encouragement of the meat export trade to Europe, and, applied to that purpose, between 20 and 30 tons of dead meat could be frozen and prepared daily. An interesting application of the Bell-Coleman machine, and one which will materially increase the comfort of passengers on long voyages, has been made and is in progress with various great ocean steamers. It consists in the use of machines of comparatively small capacity, called "provision machines," for the preservation of the ship's meat stores, thereby dispensing with the nuisance of live stock on board, which, as every passenger knows, is a most unsatisfactory and unwholesome source of fresh food towards the close of a long voyage. The Orient Line steamer *Orient*, which sailed from London for Australia early in September, with upwards of 500 passengers, had her fresh meat and poultry, &c., preserved throughout by a provision machine, which further prepared a daily supply of table ice, all in a most satisfactory manner. The Peninsular and Oriental steamer *Kaisar-i-Hind* has been fitted with a provision machine, the sold air from which refrigerates successively a meat chamber, a water-cooling chamber, a vegetable compartment, a wine-cooler, and a thawing chamber, the air passing in succession from the one to the other till, coming near ordinary atmospheric temperature, it is dimissed into space.

THE Leeds Corporation have selected Vaucher's Patent Hose, after thoroughly testing the same, 1,000 yards having been supplied by Messrs. Bensusan & Co., through their agent Mr. John Rose, Deansgate, Manchester.

A TWO-FOOT rule was given to a labourer in a Clyde boatyard to measure an iron plate. The labourer not being well up to the use of the rule, after spending a considerable time, returned. "Noo, Mick," asked the plater, "what size is the plate?" "Well," replied Mick, with a grin of satisfaction, "It's the length of your rule, and two thumbs over, with this piece of brick and the breadth o' my hand, and my arm from here to there, bar a finger.'

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 23rd November to 20th December 1880.

4852 W. Bury. Valves and valve guides for air and circulating pumps of marine engines.
4855 W. R. Lake (communicated by P. Mihan). Ventilating ships cabins &c.
4870 C. J. Galloway and J. H. Beckwith. Preventing flow of water from condensor to cylinder of steam engine.
4875 J. D. Custance (communicated by J. Johnstone). Screw propellers.
4885 C. Maw. Driving screw propellers.
4905 E. J. Johnson and J. Clayton. Life buoys.
4909 J. Edson. Diaphragm ships' pumps.
4915 W. Clarke and J. B. Farneaux. Steam steering gear.
4921 T. Monk and J. Anderton. Shaft lubricator.
4924 W. D. Scott Monrieff. Apparatus for raising steam.
4957 T. W. Richardson. Propelling vessels by hydraulic power.
4974 T. Wilson. Motive power and pumping engines.
4991 T. Nordenfelt. Battery or machine guns.
5007 J. Reaoman. Mariners and azimuth compasses.
5022 H. W. Wimshurst. Indicating the heating of bearings.
5023 A. S Hallidie. Wire ropes and cables.
5034 J. S. White. Steam ships and mode of steering same.
5050 W. H. Mirfin and E. Neild. Steam boilers.
5059 S. Crawford. Water tight doors for ships.
5083 E. Berthoud and F. Borel. Telegraphic cables and apparatus.
5093 W. Cooke and D. Mylechreest. Screw propellers.
5110 W. B. Barker. Blowing horns, whistles, &c., for marine signalling purposes.
5138 J. McCallum. Steam engines.
5153 C. O. Rogers. Propulsion of vessels.
5205 D. McPherson. Steam engines.
5206 H. J. Allison (communicated by J. McNicol. Steam generators.
5217 James Warish.
5233 E. P. Lacoste. Antifriction cylinder propellers.
5246 H. Adams. Discharge and Transhipment of cargo.
5254 F. W. Reeves. Foundations of submerged structures.
5270 M. P. W. Boulton. Rotary propellers.
5276 G. D. Davis. Ships windlasses.
5278 J. Stanfield, Dredging apparatus.
5302 W. H. Harfield. Reels &c., for coiling wire ropes on board ship.
5316 J. Sample. Life and property saving apparatus for sea use.
5330 J. Humphrys. Steam engines.
5336 J. B. Handyside (communicated by G. H. Reynolds and T. J. Rider). Valves and valve gear.

*** Any information regarding the progress, &c., of these or other patents will be gladly furnished on application.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination unde the provisions of the Merchant Shipping Act, 1854, during the month

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class 2 C, Second Class.

November 13th, 1880.

Evans John ...	2 C	Dublin.
Gray Mathias ...	2 C	N Shlds.
Jones Samuel ...	1 C	Lvrpool.
Newtou Mathw. F.	2 C	N Shlds.
Richards Wm. ...	2 C	Bristol.
Ross Alxdr. ...	2 C	N Shlds.
Softley Samuel ...	2 C	do.
Wallace Thos. ...	2 C	do.
Wolfenden Richd.	1 C	Lvrpool

November 20th, 1880.

Anderson John...	1 C	N Shlds.
Austin Wm. R.	2 C	Lvrpl.
Barnes Robert ...	1 C	N Shlds,
Barrell H. ...	1 C	London.
Callwood Wm....	1 C	Lvrpool
ChesholmFrncs.F.	2 C	N Shlds.
Donaldson Jas. A.	2 C	Dundee.
Galbraith Peter...	1 C	Lvrpool.
Guinea Richd. ...	1 C	N Shlds.
Hendry John ...	1 C	do.
HigginsonRobt.F.	1 C	Lvrpl.
Kelly James ...	1 C	do.
Kendal George	1 C	do.
Lawrie James ...	2 C	N Shlds.
Langridge John	1 C	London.
Leslie Robert ...	1 C	do.
Mee Frdk. Henry	2 C	do.
Murray Alxdr. ...	1 C	do.
McDonald Wm.	1 C	Greenck.
Neale Joseph ...	2 C	N Shlds.
Nicholson Wm.E.	1 C	Hull.
Paton William...	2 C	Greenck.
Rockcliffe Geo. R.	2 C	London.
Strafford Frdck.R.	2 C	Belfast.
Stewart Henry ...	1 C	Lvrpool.
Thompson John	2 C	do.
Thwaites W. ...	1 C	N Shlds.
Voigt August Carl	2 C	do.
Waugh Adam ...	2 C	do.
Wiseman Jno....	2 C	Greenck.
Woods John ...	1 C	Lvrpool.

November 27th, 1880.

Hedley J. W. ...	1 C	N Shlds.
Johnman Alxdr.	2 C	do.
JohnstoneJsph.W.	2 C	London.
Jones James ...	2 C	do.
Lewis Thomas...	2 C	do.
Lyon Alxdr. ...	2 C	N Shlds.
McDonald Andw.	1 C	Lvrpool.
McFarlane John	2 C	London.
MacnabArchbd.F.	1 C	do.
Meriton W. B....	2 C	do.
Newcomb Geo.	2 C	do.
Orchard Charles	2 C	do.
Smith Peter ...	1 C	do.
Smith Frederick William B. ...	2 C	do.
Smith Fredk. ...	1 C	N Shlds.
Sheldrick Samuel	2 C	London.
Stephen George	2 C	:do.
Taylor Peter ...	1 C	Lvrpool.
Williams Owen	1 C	do.
Wilks Philip H.	2 C	Bristol.

December 4th, 1880.

Black Robert A.	1 C	Glasgow
Bogg John ..	2 C	London.
Child Richard ...	1 C	Shmptn.
CousensGeo.Frdk.	2 C	do.
Dewar Alxdr....	2 C	Glasgow.
Duncan Hugh	1 C	do.
Dixon John ...	1 C	Sndrlnd.
Edward George	2 C	do.
Gow Wm. D. ...	2 C	Glasgow.
Hardie Thomas	1 C	do.
Herbz Albert H.	2 C	Sndrlnd.
Hughes Wm. O.	2 C	Lvrpool.
Lennox John ...	2 C	Glasgow.
McDowall Wm.	2 C	Lvrpool.
McGavin Geo....	1 C	do.
McLennan Alxdr.	2 C	Glasgow.
Nisbet Alxdr. ...	2 C	do.
Rendell Wm. ...	2 C	London.
Roager Wm. ...	1 C	Glasgow.
Smart Alxdr. ...	2 C	do.
Sellex John Wm.	1 C	London.
Tweedie John ...	1 C	Glasgow.
Wilson John ...	1 C	do.

December 11th, 1880.

Appleyard Abhm.	2 C	N Shlds.
Alexander Robert	1 C	London.
Brown John J....	1 C	do.
Brownhill John	2 C	Leith.
Cameron Thos. M.	2 C	do.
Cotton Wm. ...	2 C	N Shlds.
DempsterWalterP.	2 C	Leith.
Downing Robt...	1 C	N Shlds.
Diblin Wm. Chas.	2 C	London.
EmmersonHarryA.	2 C	Lvrpool.
Foggan John ...	2 C	N Shlds.
Fallside Thos. ...	1 C	Leith.
Goudie Humphrey	1 C	do.
Harrison J. M....	1 C	N Shlds.
Louie Alexdr. ...	2 C	do.
McLean Geo. ...	2 C	Glasgow.
McKay Saml. ...	2 C	do.
Maxwell Geo. ...	2 C	Leith.
Richardson Wm.	2 C	N Shlds.
Robinson Robert	1 C	N Shlds.
Smith Robt. ...	1 C	Glasgow.
Strachan Wm....	2 C	Leith.
Williams Rees G.	2 C	N Shlds.
Whitfield John	1 C	London.

December 18th, 1880.

AndersonJosiahC.	2 C	N Shlds.
Blair John ...	2 C	Glasgow,
Blair David ...	2 C	Greenck.
Copland Geo. ...	2 C	do.
Douglas Thos....	2 C	do.
Gibson H. ...	2 C	Lvrpool.
HamiltonLouisA.	2 C	N Shlds.
McAlster Geo. W.	2 C	do.
McCnaig Dvd. A.	2 C	Greenck.
Peat James ...	2 C	Lvrpool.
Preston Archbd.	2 C	do.
Riera Joseph ...	2 C	do.
Sinclair Duncan	2 C	Glasgow.
Souza de Jas. A.	2 C	Hull.
Stevenson Jas. M.	2 C	do.
Steel Michael...	2 C	N Shlds.
Ward Edward	2 C	do.

ROBERT JACKSON, Registrar-General.

e ral Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender, not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

ADVERTISEMENTS.

All Advertisements and Business communications must be addressed to the PUBLISHER, 3, Amen Corner, Paternoster Row, London, E.C., to whom all complaints respecting irregularities in delivery should be addressed. Advertisements must be sent in not later than the 25th of each month to ensure insertion in the following number.

All Accounts are to be remitted to the Office, 3, Amen Corner, Paternoster Row, London, E.C. Cheques and Post Office Orders to be made payable to E. Rowe.

SUBSCRIPTIONS.

The Subscription to "The MARINE ENGINEER," payable in advance, is (including postage) Five Shillings per annum.

NOTICE.

Readers of this Journal who may require back numbers, are requested to order them as soon as possible ; all are to be had at the present time, but only a limited number.

The Marine Engineer,
LONDON, FEBRUARY 1, 1881.

EDITORIAL NOTES.

WE still know apparently very little as to the laws and best conditions of propulsion by the screw propeller. We continually hear of experiments which produce results more or less unexpected. It has long been a popular belief that the propulsion of a screw is more effective when deeply immersed than nearer the surface, and with a tendency to make broken water. We note, however, that results have been lately obtained by Messrs. Yarrow & Co. which point to a somewhat different conclusion. Following this idea that extra efficiency could be obtained by a deeper immersion of the propeller, they fitted a torpedo launch with a propeller projecting at a downward angle under the counter of the boat in a line with the forward keel. The dead wood was removed. The result in speed, however, was much below expectations, the maximum speed not exceeding 18½ knots, with an exertion of 510 h.p. As the displacement of the boat was only 32 tons, its length being 86 feet and beam 11 feet, this was not by any means a favourable result. The propeller was then removed from its experimental position, the dead wood again added, and the propeller fitted in the usual way. The increase in speed was now most marked, averaging an increase of 17 per cent. the maximum speed attained with the same power, reaching 21½ knots per hour. It is a matter of general speculation as to whether the *Livadia* will prove a type for a new class of ironclads. Should this prove so she will have the great peculiarity that her sides recede from a water line at such an acute angle that no ordinary conical shot would be able to pierce her shell, even if of very slight material. This is of so important a character that should an enterprising enemy attack us with a fleet of such turbot gun-boats, they could with ease, if possessed of high speed, rapid manœuvring power, and inaccessibility to our shot, soon dispose of our whole fleet, and commit what depredations they liked with impunity on our merchant service. It is reassuring, however, to note from the interesting paper of General W. N. Hutchinson that the duel between armour and guns is not even thus solved in favour of armour, and that General Hutchinson will undertake that his disc gun shall pierce such an inclined surface. This is effected by the peculiar rotation given to the shot, which is rolled out of the barrel of the gun, and can be given a forward or reverse rotation similar to the "side," "screw" or "effect" of a billiard ball. General Hutchinson claims that inasmuch as the "screw" or "effect" of the billiard ball may be used to cause special absorption of its impact by the ' cushion," so the same screw or backward rotation of a disc shot will cause it to impinge with much more deadly effect upon an inclined surface than an ordinary conical shot. It is certainly startling to contemplate the very deadly effect that such a rotating shot would have after it had pierced a skin, and begun flying about the enclosed space of the interior as a spinning top would do in a box. We should rather not be there to see such an extremely interesting but dangerous exhibition.

NAVAL architecture for offensive and defensive purposes seems to be a never-ending and disheartening business. We no sooner pride ourselves upon the wonderful speed and destructive power of our torpedo fleet when it is ascertained that the Nordenfelt gun has sufficient penetrative power to riddle a torpedo boat through and through before it could approach close enough to effect its dangerous errand. As the application also of the electric light is becoming very general in the fleet, there would be little or no chance for a torpedo boat to remain unseen. The emissary of destruction then is much more likely to meet an untimely end as at present constructed than to effect much harm upon the enemy. The obvious course is to so increase the strength of the armour plating as to render the torpedo boats impervious to the bullets of the Nordenfelt gun. The consequent increase of weight, however, would be sufficient to materially retard the speed of the boat which is now considered so necessary to its efficiency. As a compromise it has been determined to strengthen the plating on the conning tower and other most vulnerable parts. This, however, is evidently only a makeshift, and a new class of torpedo boats suited to resist the Nordenfelt projectiles must be designed to steam at the present high speeds.

THE Tyne Commissioners are considering the undertaking of extensive works for the better protection of the harbour at North Shields. The late storm was so marked by considerable damage to shipping in the harbour that a petition of fifty-seven shipowners has been submitted to the Commissioners for a breakwater to be erected from the sand end off or near to Clifford's Fort, and extending so far as is deemed prudent with the safe navigation of the channel. The engineer (Mr. Messent), is, however, of opinion that no breakwater outside the harbour would suffice to entirely protect it from the present heavy seas, which have been much augmented by the straightening of the channel. He considers that the extension of the north pier to a further distance of 300 feet would be all that was advisable in the way of outside works and that a temporary breakwater or groyne might be constructed in the harbour opposite the South Pier shipping stages. This would be certainly the most economical undertaking, and if effective, the most advisable.

WE are glad to see that the past year's work in shipbuilding on the Clyde has been thoroughly satisfactory, and is an excellent testimony to the thorough revival of the shipping trade. The results of the last year in total tonnage has only been surpassed by the results of 1874 which has been called the "big year." The total tonnage for 1880 reached 236,579 tons which is only less by 25,851 tons than the exceptional total of 1874 viz., 262, 430 tons. The figure for last year shows, however, a very substantial increase upon 79, 78 and 77, so that the upward movement is now thoroughly marked and confirmed. 1881 has also commenced with such favourable promise that there is every prospect that it will exceed 1874 in its output, and will be then the highest ever known on the Clyde. Messrs. Elder & Co., stand at the head of the list with a total output of 32,282 tons, of which the *Livadia* represents an item of 12,802 tons. A striking feature of last year's work is the large amount of shipping built in steel, representing an aggregate 42,688 tons, the work of the previous year in steel only amounting to 18,08 tons. The form of construction known as cellular bottom and bracket floor has been largely adopted on the Clyde, notably by Messrs. Wm. Denny & Bros., and Messrs. Alexander Stephen & Sons, in conjunction with the system of water ballast. It seems almost probable that in a few years this system of cellular bottom and water ballast will be most extensively applied to the majority of merchant steamers.

THE North Eastern Marine Engineering Company are about largely to extend their works. Their premises at Sunderland have been already for some time overcrowded, and the company have now secured twenty acres of land at Wallsend-on-the-Tyne, where they are about to spend £265,000 on the construction of new marine engineering works. These works will be fitted with all the latest appliances and tools for turning out the work in a first-rate and expeditious manner. The North Eastern will then become the largest marine engine builders in the world. As several streets of houses for their workpeople are to be erected by the works there is every prospect of Wallsend growing into a considerable industrial town. The new works are to be under the management of Mr. Allan, whose success on the Wear argues well for the success or the new undertaking. We understand that a large forge is to form part of the establishment, so that crank and propeller shafts may be made on the premises. This addition to the manufactures of the firm will now make it completely self-contained, so that it makes every detail of marine engine or boiler on its own premises, and is independent of outside work except for raw material, plates, &c.

THE Greek Government have just contracted with Messrs. Yarrow & Co., Poplar, for the construction of six of their improved first-class torpedo boats. They will be of the well-known formidable Batoum class, and similar in every respect to the vessel of that name which the firm built last year for the Russian Government.

ON THE EXPERIMENTS WITH THE PERKINS MACHINERY OF THE STEAM YACHT "ANTHRACITE."

From the Journal of the Franklin Institute.

By Chief-Engineer Isherwood, United States Navy.

THE *Anthracite* is the British steam yacht, 86 ft. 4 in. long between perpendiculars, 16 ft. 1 in. greatest breadth of beam, 10 ft. 2 in. depth of hold, and 6 ft. mean draught of water, that made a brief visit to the United States during the last summer for the purpose of exhibiting her machinery, which is constructed according to the system of Mr. Loftus Perkins, and embraces some novelties of mechanical detail, as well as the use of steam of higher pressure with greater expansion than has ever before been employed. The engine drives a 2-bladed screw of 6 ft. 1 in. diameter and 9 ft. pitch, and is peculiar in the compounding of its cylinders. The arrangement of the tubes of its surface condenser is also peculiar, and the design of the boiler is likewise new.

The superior economy of fuel claimed for this system is inferred from the exceedingly high steam pressure employed and the very great measure of expansion with which it is used, both being largely in excess of any previous practice. And, with the view of giving the fullest effect to the expansion, provision is made in the boiler for highly superheating the steam. In other words, the system of Mr. Perkins is an attempt to realize practically the gain in economy inferable theoretically from the use of steam of higher pressure than heretofore employed and with a measure of expansion correspondingly greater. On these two hang all the law and the prophets of this system. There is nothing new in either, the system of Mr. Perkins being merely an extension of what has been in progress for many years. It embodies no new principles, but only endeavours to give those previously employed a more extended application by means of mechanical details better adapted for that purpose.

The steam is generated from water distilled from fresh water and the wastage, inevitable in any case, is supplemented with water distilled from fresh water carried for that contingency, water distilled from sea water not being considered sufficiently pure for use with this system of machinery. The distillation is effected in a separate vessel. No lubricants are used in the valve chests and cylinders, but a bronze of peculiar composition and manipulation in manufacture is relied on without lubrication for the material of the rubbing surfaces of the steam valves and pistons, and, as the cylinders are vertical, the water lubrication, which in the engine of the *Anthracite* was excessive, in conjunction with this bronze appears to be sufficient to prevent abrasion. Experience with horizontal cylinders, or with those having but a slight water lubrication, might not be so satisfactory. The manufacture of this bronze is a trade secret.

Whether any gain in economy over the best existing practice can be obtained by employing steam of higher pressure with greater expansion is a question to be answered by experiment only, like any other physics. It cannot be answered inferentially from an abstract consideration of the properties of steam of high and low pressures, or from the gain due to the laws of expanding gases. The question mnst be directed to Nature, who alone is competent to give a correct reply, and it must be put in the language of experiment under the precise conditions in which the steam is to be used, so that the modifications effected by the material of the mechanism and by its mode of action may be included in the final result.

Only two experiments have been made with the machinery of the *Anthracite* to the knowledge of the writer; one in England on the 22nd. of May, 1880, by Mr. F. J. Bramwell, an expert employed for that purpose by the Directors of the Perkins Engine Company, whose report to them was reprinted in the September number of this journal for 1880; the other was made by order of the Navy Department on the 13th. and 14th. August, 1880, by a Board of Chief Engineers to the United States Navy, presided over by Chief Engineer Loring.

The results of the two are widely discordant. From the very able and complete report of the Navy Department I have taken freely all the facts and calculations reproduced in this paper; and in a succeeding one I shall give the corresponding data the results of Mr. Bramwell's experiment, similarly arranged, the facts of which cannot be found in his report as printed in this journal, but which the writer has obtained from authentic drawings of the machinery and from the indicator diagrams given in a supplement to that report to the Directors and reproduced in their lithographic copy for distribution.

Before giving the data and results of the experiments it is necessary to preface them with a description of the machinery with which and the manner in which they were made.

ENGINE.

There is one engine of the vertical, direct-acting, inverted type, with three compounded cylinders of different diameters but same stroke of piston, the first two being single acting and the third double acting. The first or smallest cylinder is placed immediately above the second or next largest with their axes in the vertical line. The third or largest cylinder has its axis parallel to the axes of the first and second cylinders, and is situated forward of them relatively to the vessel. The axes of all the cylinders are in the vertical plane passing lengthwise through the centre of the vessel. The casting of the first cylinder forms also the top cover of the second cylinder, the bottom of the first being open to or in common with the top of the second. The pistons of these two cylinders are connected by a casting of nearly the diameter of the first cylinder, and the space between the pistons is in common with the receiver. The first cylinder receives into its top the steam direct from the boiler, aud its piston makes a downward stroke, at the end of which the steam is exhausted through a connecting pipe of 6·4918 square inches cross area and 29 in. length direct into the bottom of the second cylinder, whose piston makes the return upward stroke. From the second cylinder the steam is exhausted into a receiver from which the third cylinder is supplied alternately at top and bottom; this last cylinder exhausts into a surface condenser. The engine thus, in effect, acts like an ordinary compound engine of two cylinders with an immediate receiver.

The peculiar arrangement or combination of the first and second cylinders is for the same purpose as the compounding of the two cylinders of an ordinary compound engine, namely, to lessen the initial pressure on the crank pin, and to reduce the cylinder condensation by making the sum of the products of the difference of the temperatures due to the extreme pressures in the cylinders by the inner surfaces of the cylinders, less than in the case of a single equivalent cylinder giving the same mean pressure with the same boiler and final back pressure and the same measure of expansion. It is merely a further extension of the principle of the compound engine, being the same thing, only more so.

The first cylinder has at its top two double beat valves of the Cornish type, one for admitting the steam and cutting it off when a portion of stroke of the cylinder is completed; the other for exhausting it at the end of the stroke into the second cylinder. This exhaust valve of the first cylinder is thus the steam valve of the second cylinder. The second cylinder has only one similar double beat valve and it exhausts the steam from the second cylinder into the receiver. The third cylinder has an ordinary three-ported slide valve with an expansion slide upon its back, the latter being worked from a prolongation upwards of the circulating pump rod. The valves of the first and second cylinders are worked by two eccentries and a Stephenson link placed at one end of the crank shaft. The valve of the third cylinder is similarly worked by two eccentrics and a Stephenson link placed at the end of the crank shaft. The reversal of the movement of the engine is effected by these links.

The Cornish valves are directly moved by lifting rods which rise and fall vertically, and whose upper end fit loosely into close-topped sockets made in the valves themselves, so that after the latter are seated the rods can recede from them. Cams working in yokes made in the lifting rods control the adjustment of these valves, whose upper faces are divided into two sections.

The cylinders and their covers are steam-jacketed in a peculiar manner. Coils of wrought iron pipe being properly placed in the mould, the metal of the cylinders and covers was cast around them and they thus became imbedded in its centre. The water of condensation in the jackets was delivered into the condenser. The interior of the cylinders and their covers was efficiently lagged.

From the bottom of the piston of the second cylinder there proceeds a piston rod whose lower end is secured into a cross-head moving between guides. From the cross-head journal the connecting-rod continues directly to the crank pin. From the bottom of the piston of the third cylinder there proceeds a piston rod whose lower end is secured into a cross-head moving between guides, and from the journal of this cross-head a connecting rod proceeds directly to the crank pin. The crank shaft has two crank pin journals and four main journals.

The areas of the piston of the three cylinders, exclusive of their rods, have the following proportions: Calling the area of the piston of the first cylinder 1·00000, the area of the piston of the second cylinder is 4·26212, and that of the third cylinder is 17·20179 including both sides of the piston as the third cylinder is double acting while the first and second cylinders are single acting.

In the first cylinder the steam is used for about the first half of the stroke of its piston without expansion, and during the remaining half expansively. In the second and third cylinders the steam is wholly used expansively, the cut-off valve of the third cylinder acting only as a throttle valve to increase the back pressure against the piston of the second cylinder.

The circulating pump supplying the refrigerating water to the condenser is worked by a lever articulated to the piston rod of the third cylinder, and the air pump is worked by a similar lever similarly articulated to the piston rod of the second cylinder. The feed pumps and bilge pumps are worked by the cross-heads of the circulating pump and of the air pump. All the pumps are vertical and single acting.

The surface condenser is composed of galvanized wrought iron tubes, one-half of which have an inner diameter less than the outer diameter of the remaining half, so that those of the smaller diameter can be placed within those of the larger diameter and leave an annular space between when the axes of both coincided. All the tubes stand vertically and are arranged in pairs, a smaller and a larger diameter tube constituting a pair, with the smaller placed concentrically inside of the larger. Thus one-half of the tubes having the same diameter are outer tubes and the remaining half having the same diameter are inner tubes. The outer tubes have their upper end closed and their lower end open and screwed into their horizontal tube plate. The inner tubes have both ends open and are screwed by their lower end into their horizontal tube plate, which is directly beneath the first tube plate. The upper open end of the inner tubes is within a very short distance of the upper closed end of the outer tubes. The refrigerating or injection water is forced by the circulating pump up the inner tubes and thence into the annular space between the inner and outer tubes, down which it descends and passes overboard.

All the tubes are surrounded by the condenser shell, which forms, with the two tube plates, three compartments—one above the upper tube plate, one between the tube plates, and one beneath the lower tube plate. The upper compartment receives the exhaust steam from the third cylinder, which steam surrounding the outer tubes is condensed on their exterior surfaces, the water of condensation trickling down to the upper tube plate; this compartment communicates with the air pump which drains it. The lower compartment receives the refrigerating water from the circulating pump and distributes it to the inner tubes. The intermediate compartment, or the one between the tube plates, receives the refrigerating water from the annular spaces between the tubes of each pair, and passes it to the outboard delivery valve.

This arrangement of the tubes is exceedingly compact, makes perfectly tight joints with the tube plates, and allows free and independent expansion to each tube, but it has serious disadvantages as compared with the ordinary arrangement. It is greatly less accessible for examining, removing or replacing the tubes, few or many; in fact, these operations require the condenser to be taken apart; for, although the top of the shell is removable after the manner of a cover, yet, practically, the long flexible tubes, once firmly screwed into their plates and rusted there, could not be unscrewed by their upper ends, as intended by the designer. The power required to work the circulating pump is very much greater on account of the sharp reversal of the refrigerating water at the upper ends of the tubes, and on account of the resistance of the greater quantity of tube surface over which the water must be passed. The quantity of tube service is nearly double, the surface of all the inner tubes being in excess of the surface required with the ordinary arrangement. This, also, in the same proportion, increases the weight of the condenser and the cost of its manufacture. The sole use of the inner tubes is to convey the refrigerating water to the upper end of the outer tubes, only the exterior surface of which constitute the condensing surface; hence, all the inner tubes are in addition to what would be required with the ordinary arrangement to give equal condensing surface. The designer was doubtless led to the adoption of his arrangement of tubes by the perfection of the joint it afforded; for, with his system, any leakage of refrigerating water (which would be sea water) into the compartment receiving the water of condensation was inadmissible, as that much sea water would have passed into his boiler, but he paid dearly for this advantage.

The following are the principal dimensions and proportions of the engine:—

Number of cylinders,	3.
Diameter of the 1st cylinder (single acting),	7¾ inches.
Stroke of the piston of the 1st cylinder,	15 inches.
Area of the piston of the 1st cylinder,	47·173 sq. inches.
Space displacement of the piston of the 1st cylinder, per stroke,	0·4094884 cu. ft.
Space in clearance and steam passage of 1st cylinder,	0·0856481 cu. ft.
Diameter of the 2d cylinder (single acting),	15 13-16 inches.
Diameter of the piston rod of 2d cylinder,	2¾ inches.
Stroke of the piston of the 2d cylinder,	15 inches.
Net area of the piston of the 2d cylinder,	190·389 sq. inches.
Space displacement of the piston of the 2d cylinder, per stroke,	1·6526823 cu. ft.
Space in clearance and steam passage of 2d cylinder	0·3116325 cu. ft.
Diameter of the 3d cylinder (double acting),	22 13-16 inches.
Diameter of the piston rod of the 3d. cylinder,	2¾ inches.
Area of upper side of piston of 3d cylinder,	408·700 sq. inches.
Net area of lower side of piston of 3d cylinder,	402·760 sq. inches.
Mean area of the two sides of the piston of 3d cylinder	405·730 sq. inches.
Stroke of the piston of the 3d cylinder,	15 inches.
Mean space displacement of the piston of the 3d cylinder, per stroke,	3·5219618 cu. ft.
Space in clearance and steam passage of 3d cylinder at one end,	0·3194444 cu. ft.
Area of steam port of 1st cylinder (1¼ by 2½) inches =)	3⅛ square inches.
Area of exhaust port of 1st cylinder (1¼ by 4 inches =)	5 square inches.
Area of exhaust port of 2d cylinder (1½ by 13½ inches =)	20¼ square inches.
Area of steam port of 3d cylinder (2 by 16¾ inches=)	33½ square inches.
Area of exhaust port of 3d cylinder (4 by 16¾ inches =)	67 square inches.
Depth of piston of 1st cylinder occupied by the packing rings,	3½ inches.
Depth of piston of 2d cylinder occupied by the packing rings,	3½ inches.
Depth of piston of 3d cylinder occupied by the packing rings,	4⅛ inches.
Total depth of piston of 2d cylinder,	5 inches.
Total depth of piston of 3d cylinder,	5⅝ inches.
Thickness of metal of all the three cylinders	1½ inches.
Total interior surface of the 1st cylinder exposed to the contact of the steam, including the upper surface of the piston and the surfaces of the steam passages and clearance,	5·09236 sq. feet.
Total interior surface of the 2d cylinder exposed to the contact of the steam, including the lower surface of the piston, half the surface of the piston rod, and the surfaces of the steam passages and clearance,	13·06982 sq. feet.
Total interior surface of the 3d cylinder exposed to the contact of the steam, including both surfaces of the piston, half the surface of the piston rod, and the surfaces of all the steam passages and clearances,	22·52750 sq. feet.
Outside diameter of the wrought iron pipe composing the coils of the steam jackets for the three cylinders,	⅝ inch.
Inside diameter of the wrought iron pipe composing the coils of the steam jackets for the three cylinders,	⅜ inch.
Distance between the axes of the coils of the wrought iron pipe composing the steam jackets for the three cylinders	1 15-16 inches.
Per centum of the interior surface of the cylinders steam jacketed, being the ratio of the inside surface of the wrought iron pipe composing the coils of the jackets to the interior surface of the cylinders. These coils are in both top and bottom of the cylinders as well as around the sides	60·80
Clearance of all the cylinders	⅛ inch.
Inner diameter of the steam pipe from boiler	1⅛ inches.
Cross area of the steam pipe from boiler	0·994 sq. inch.
Ratio of cross area of steam pipe to area of piston of 1st cylinder	0·02107
Cross area of pipe connecting top of 1st cylinder with bottom of 2nd cylinder	6·4918 sq. inches.
Length of pipe connecting top of 1st cylinder with bottom of 2nd cylinder	29 inches.

Ratio of the space displacement of the piston of the 1st cylinder in equal time to that of the piston of the 2nd cylinder ...	4·03597
Ratio of the space displacement of the piston of the 1st cylinder in equal time to that of the piston of the 3rd cylinder ...	17·20179
Ratio space displacement of the piston of the of the 2nd cylinder in equal time to that of the piston of the 3rd cylinder ...	4·26212
Ratio of the aggregate displacements of the pistons of the 1st and 2nd cylinders in equal time to that of the piston of the 3rd cylinder ...	3·41578
Ratio of the space in clearance and steam passage of 1st cylinder to the space displacement per stroke of its piston ...	0·209159
Ratio of the space in clearance and steam passage of 2nd cylinder to the space displacement per stroke of its piston ...	0·188561
Ratio of the space in clearance and steam passage of 3rd cylinder to the space displacement per stroke of its piston ...	0·090707
Diameter of crank shaft	5½ inches.
Condensing surface in condenser ...	422 square feet.
Diameter of air pump (one, vertical and single acting) ...	11½ inches.
Stroke of air pump piston ...	4½ inches.
Diameter of circulating pump (one, vertical and single acting)...	11½ inches.
Stroke of piston of circulating pump	4½ inches.
Diameter of feed pumps (two, single acting)...	2 inches.
Stroke of feed pumps' pistons ..	4½ inches.
Diameter of bilge pumps (two, single acting)...	3 inches.
Stroke of bilge pumps' pistons ...	4½ inches.
Length in vessel occupied by engine and boiler	22½ feet.
Total weight of machinery, including engine, boiler, screw shaft, screw, and all appurtenances except water in boiler ...	25 tons.
The tank in the engine room, carrying distilled water for supplying the boiler wastage, contains...	280 pounds.

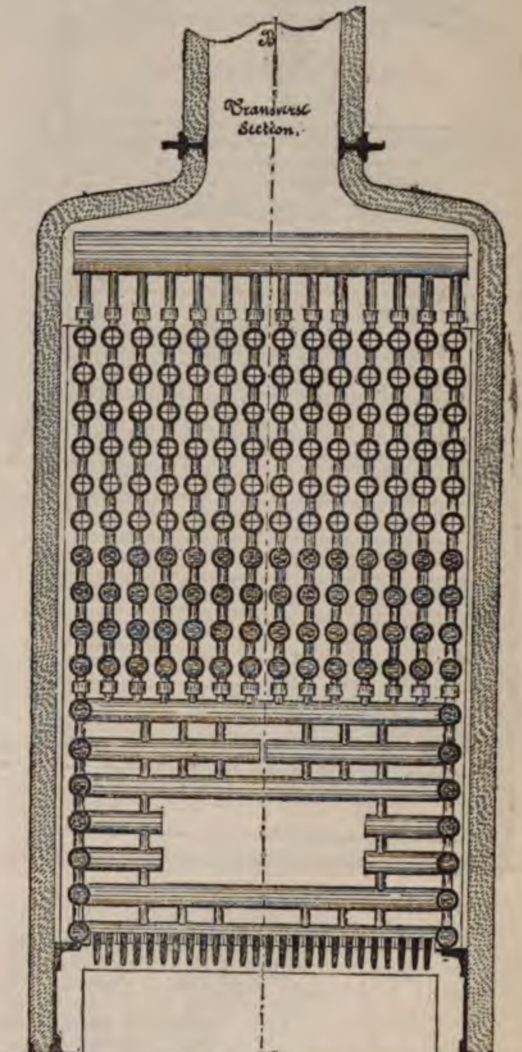
It will be observed from the above dimensions that the spaces in the clearances and steam passages of the cylinders are enormous, as compared with what are usually found in good practice, being from twice to four times greater than necessary, and involving a proportionally decreased economic effect from the steam. Although the Cornish equilibrium valves may be indispensable for working with steam of the high pressure intended in the first and second cylinders, yet they may be arranged so that the spaces in the clearances and steam passages shall not exceed 5 to 6 per centum of the space displacement of the respective pistons per stroke. And, certainly, the ordinary slide valve can be adapted to the third cylinder without requiring over 9 per centum of the space displacement of its piston per stroke in waste spaces.

The disadvantage of the unusually large waste spaces at the ends of the cylinders is not limited to the loss of steam required to fill them, but extends to the loss of steam due to its condensation on the surfaces of these spaces. These losses of economic effect, greater in the engine of the *Anthracite* than is found in ordinary engines, are not inherent to the Perkins system, and may easily be eliminated by a better design of mechanical details.

The method of steam jacketing the cylinders is very inefficient, so much so, indeed, that probably but little economic effect is obtained from their use. The jackets, as already described, are composed of wrought iron pipe embedded in the metal of the cylinder which was cast around them. By this arrangement the whole heating surface of the jacket is composed of the inside surface of the pipe. The steam from the boiler, being admitted at the top of the coil, follows it to the bottom, becoming in part condensed during the progress, the water of condensation filling the lower part of the coil, which is consequently cooler than the boiler steam in the upper portion, and, to that extent, less efficient. The heat of the steam or of the hot water has to be accepted by the wrought iron pipe, which then delivers it to the cast iron of the cylinder, the heat wave being much impeded by this additional barrier. With the ordinary steam jacket, the boiler steam is at once in direct contact with every particle of the cast iron cylinder; the jacket has the maximum temperature, and the heat is communicated to the entire surface of the cylinder without the interposition of a single impediment. In the Perkins system, the heat-delivering surface of the steam jacket or coil is only 60·8 per centum of the interior surface of the cylinder, owing to the distance at which the coils are placed apart. With the ordinary steam jacket, the heat-delivering surface is co-extensive with the interior surface of the cylinder. In fact, the Perkins system of steam jacketing cannot be considered as over one-half the efficiency of the ordinary system. The only advantage of the coil system of jacketing is the mechanical one of acting as bands or hoops around the cylinder, and thus increasing its resistance against internal pressure; but for the proper purpose of a steam jacket, which is the prevention of cylinder condensation, it is greatly inferior to the ordinary system. The water of condensation from the steam jackets, being at nearly the boiler temperature, was discharged into the condenser instead of into the boiler, and so lost nearly the heat due to the difference between the condenser and boiler temperatures.

BOILER.

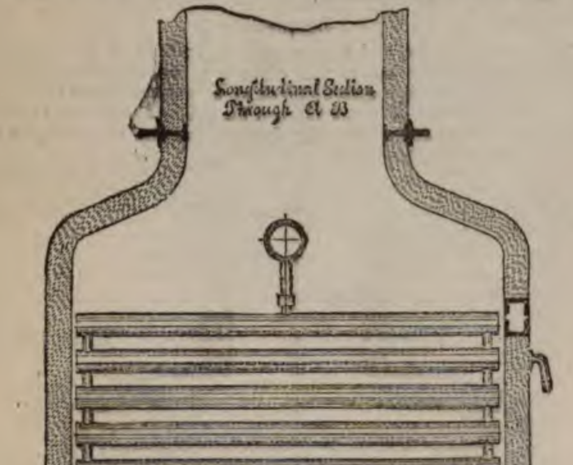
There is one boiler, and it is composed entirely of water tubes enclosed in a double shell of thin plate iron, the intervening space of which is filled with vegetable black as a non-conductor of heat. The entire thickness of the shell is 4 in. About one-half of the tube surface is steam generating surface, and the remaining half is steam superheating surface.



The boiler has one furnace, the grate of which is horizontal, forming a parallelogram 45¾ in. wide and 49 in. long; the corners of this parallelogram are rounded on radii of 6½ in.

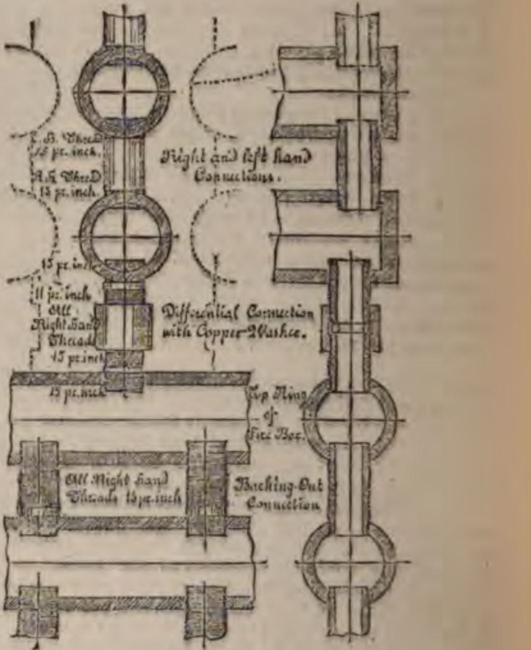
All the steam generating tubes are water tubes, that is to say they contain the water to be converted into steam, and they are completely surrounded by the hot gases of combustion. All the superheating tubes contain steam and are completely surrounded by the hot gases of combustion. All the tubes, both steam generating and steam superheating, are of iron, 3 inches in outside diameter and $2\frac{1}{4}$ inches in inside diameter, the thickness of the metal being $\frac{3}{8}$ inch.

The grate is enclosed by horizontal tubes, seven in number, arranged one immediately over the other so as to form the sides of the furnace. These tubes are separated vertically by spaces $1\frac{3}{4}$ inches high in the clear. Each of these tubes is bent to the form of the grate which it just encloses, and the ends of the tubes are closed. The opening for the furnace door is made by allowing its width between the ends of two tubes, the height being composed of two tubes and three intervening spaces, that is $11\frac{1}{4}$ inches. The ends of each of the remaining tubes are separated by a space of $\frac{1}{2}$ inch, otherwise the two ends of the same tube would have abutted. The seven horizontal tubes forming the sides of the furnace are connected together at intervals of about 8 inches by vertical pipes $1\frac{5}{16}$ inches in outside diameter and $\frac{7}{8}$ inch in inside diameter; the extreme length of each of these short vertical pipes is $2\frac{11}{12}$ inches, including the portions screwed into the two horizontal tubes it connects. These short vertical pipes are secured into the horizontal tubes with right and left hand threads, being screwed simultaneously into the upper and lower horizontal tubes they connect.



Above the seven tubes just described as forming the sides of the furnace, and extending over the grate, are one hundred and forty tubes, each 55 inches in extreme length and having both ends closed. These tubes are horizontal and parallel. They are arranged ten tubes vertically and fourteen tubes horizontally. The vertical spaces between the tubes are $1\frac{3}{4}$ inches high, and the horizontal spaces between them are $\frac{3}{4}$ inch wide. The tubes of each of the fourteen vertical rows are placed over each other, their axes being in the same vertical plane, and they are connected together at each end by a short vertical pipe of the same dimensions described for the connections of the seven horizontal tubes forming the sides of the furnace. Between the ends there are no connections, nor are the tubes of the different vertical rows connected horizontally with each other. Each vertical row of ten tubes thus forms a distinct section of the boiler. The lower tube of each vertical row is connected with the upper of the seven horizontal tubes forming the sides of the boiler in the same manner as with the tube above it, namely, by a short vertical pipe at each end. The axes of the corresponding tubes of the fourteen vertical rows are in the same horizontal plane.

Above the tubes just described, and with its axis at right angles to their axes, is a steam collector composed of an iron pipe $51\frac{3}{4}$ inches in extreme length, 5 inches in outside diameter and 4 inches in inside diameter, thickness of metal $\frac{1}{2}$ inch. This pipe is placed at the centre of the tubes with its axis 11 inches above the axes of the tubes of the upper row. It is connected with the tubes of each of the ten vertical rows by a vertical pipe at the centre of their length $1\frac{5}{16}$ inches in outside and $\frac{7}{8}$ inch in inside diameter. The steam pipe leading to the engine, $1\frac{1}{4}$ inches in inside diameter, proceeds from the steam collector.



The whole of the tubes, both those surrounding the grate and those lying above it, including the steam collecting pipe, are surrounded entirely by the hot gases of combustion, the water and steam being contained within them.

Above the steam collector the shell of the boiler is arched over, and at its centre the chimney is placed. The shell is extended below the grate sufficiently to form a closed ash pit which is provided with a door.

Large hinged doors are constructed in the shell of the boiler boiler above the furnace door. These doors uncover, when opened, one end of each of the one hundred and forty tubes, so that they can be swept easily of soot and ash from the outside, the tubes lying in the direction of the grate bars and at right angles to the doors for sweeping.

There is no fixed water level. It can be carried anywhere at will. All the tube and pipe service below it is steam generating surface, and all the tube and pipe surface above it, including the steam collector, is steam superheating surface. During the experiment made at the New York navy yard with the machinery of the *Anthracite*, the water-level in the boiler was carried steadily at the top of the fourth horizontal row of the one hundred and forty tubes above the furnace. That is to say, the entire surfaces of this row of tubes and of all those below it were water heating surfaces, and the entire surfaces of all those above it, including the steam collector, were steam heating surfaces. The areas of water heatingand steam heating surfaces about to be given were calculated according to this water level, as well as the steam room and water room.

	Length extreme of the boiler	5 feet 3 in.
	Breadth extreme of the boiler	4 feet 10½ in.
	Height of the boiler	9 feet 2 in.
	Area of grate surface	15·3158 sq. ft.
	Area of water heating surface, calculated for the exterior circumference of the tubes	300·24 sq. ft.
	Area of water heating surface, calculated for the interior circumference of the tubes	225·49 sq. ft.
	Area of steam superheating surface, calculated for the exterior surface of the tubes	325·89 sq. ft.
	Area of steam superheating surface, calculated for the interior surface of the tubes	239·20 sq. ft.
	Cross area for draught between the tubes	3·724 sq. ft.
	Steam room	11·048 cu. ft.
	Water room	10·109 cu. ft.
By Calculation.	Weight of tubes and their connections in boiler	8264 pounds
	Weight of the grate bars	728 pounds
	Weight of the ash pit	186 pounds
	Weight of the boiler base or bearer	380 pounds
	Weight of the chimney	280 pounds
	Weight of the metal in the boiler casing	1804 pounds
	Weight of vegetable black filling for the casing	3750 pounds
	Total weight of boiler, exclusive of water	15392 pounds
	Weight of water at 62 degrees Fahrenheit in boiler	630 pounds
	Total weight of boiler and its contained water	16020 pounds
	Square feet of water heating surface, calculated for exterior surface of the tubes, per square foot of grate surface	19·6033
	Square feet of water heating surface, calculated for interior surface of the tubes, per square foot of grate surface	14·7227
	Square feet of steam superheating surface, calculated for exterior surface of the tubes, per square foot grate surface	21·2178
	Square feet of steam superheating surface, calculated for interior surface of the tubes, per square foot of grate surface	15·6179
	Square feet of grate surface per square foot of cross area for draught between the tubes	4·1127

(*To be continued.*)

CLYDE SHIPBUILDING IN 1880.

IT is gratifying to be able to state that there has been a very marked improvement in the Clyde shipbuilding trade since the beginning of last year, and this has been steadily maintained with an increased order of new contracts. The returns which have been kindly furnished by the builders show that 242,774 tons, representing 226 steam vessels and 29 sailing ships, have been put into the river, giving an increase of 68,954 tons over that of 1879. Sailing ships have been at a complete discount, the only firm on the Clyde doing much in that line being Messrs. Russell & Co., Port Glasgow, who have launched no fewer than seven during the year. A great many of the new steamers are of very large dimensions, and many of them have been constructed of steel. While the returns of 1879 showed a falling-off compared with the previous year of over 40,000 tons, it is satisfactory to note that the present bulk so largely. In 1878 Messrs. Denny Brothers headed the list with 22,048, followed by Messrs. Barclay, Curle, & Co. with 20,707; but this year Messrs. John Elder & Company came to the front with 32,775, this splendid turnout being considerably swelled by the Czar's yacht, which caused such a sensation in shipbuilding and marine engineering circles during the past season. In 1879 the same firm were also at the top of the list with 16,895 tons, closely followed by Messrs. Alex. Stephen & Sons with 16,304, and W. Denny Brothers with 16,236. In consequence of the present uncertainty which prevails with regard to the exclusive use of steel in the future construction of vessels, the prices of the best brands of iron have kept very steady for some time, and can now be obtained at such a reasonable figure as will leave some margin of profit to the builders. Amongst the larger Clyde shipbuilding firms the books are presently pretty full of contract work, and tenders lately sent in are from 7½ to 10 per cent. higher than they were five months ago. As an indication of this, some builders have had to refuse contracts from owners with whom they have had long connections; and we have just heard of a new firm recently started in Belfast (Messrs. Workman, Clark, & Co.) receiving an order to construct a large steamer, 400 feet long, for Messrs. George Smith & Co.'s "City Line;" and two vessels for Messrs. A. C. Colvil & Co., Glasgow. The amount of tonnage on hand at present is very large, and it is not too much to say that the close of 1881 will see the largest output of shipbuilding and marine engineering in the annals of the trade. As will be observed from the list of work on hand, published below, three of the largest firms have close upon 70,000 tons to put into the river. Messrs. Jas. & Geo. Thomson head the list with close upon 40,000 tons, over 30,000 of which is under construction for the "Cunard Line," followed by Messrs. John Elder & Co. with nearly 23,000, Messrs. Dobie & Co. with about 17,000, and Messrs. Robert Napier & Sons with about 15,000. It may be remembered that in the autumn of the present year a movement was started by the ironworkers for an increase of pay, and spread to the engineers and blacksmiths, and the employers have conceded an advance of 7½ per cent. The shipwrights have now followed in the same direction, and their memorial is presently under consideration. Appended will be found tabulated statements showing the number, description, tonnage, and, in most cases, indicated horse-power of steam vessels, together with sailing vessels, launched during the year in each of the yards on the Clyde:—

JOHN ELDER & Co., Govan.

Name and Description of Vessel.	Gross. Tonnage.	Indicated H. P. of Engines.	Owners.
H.M.S. Rambler, s.s	645	790	British Government
" Ranger	645	790	Do.
" Niger, p.s.	500	620	Do.
Livadia s.y.	11802	12383	Russian Government
Prins Hendrik p.s.	1592	4000	Steamship Company Zeeland, Holland,
Coanza, steel s.s.	1518	1150	Britain & SteamNavigation Co., Glasgow
Malemba, steel s.s.	1521	1180	
Moise iron, s.s.	1862	2500	Cie. Gle. Trans., Paris
St. Augustine iron, s.s.	1863	2563	Do.
Isaac Persire iron s.s.	1863	2400	Do.
Abdel Kader, iron s.s.	1863	2600	Do.
El Mensajers, steel s.s.	382	220	East Argentine Railway Co., London
Maipir steel, p.s.	800	1700	Argentine Republic
Launch, s.s.	12	60	Russian Government
Leon XIII. iron	2202	1838	Mar. de Campo Mdrd.
Launch steel, s.s.	5	30	Agentine Republic
Garth Castle iron	3700	3200	D Currie & Co., Lon.

Tonnage, 32,755; indicated H.P., 38124.

ALEXANDER STEPHEN & SONS, Linthouse.

Vincenzo Florio, i. s.s.	2916	370	J. & V. Florio & Co., Palermo:
Washington, i. s.s.	2913	370	Do.
Lennox, iron s.s.	2122	240	J. Warrack & Co., Leith
Carlo, iron	1316	130	Tellefsen, Wills, & Co., Cardiff
Earlof Rosebery, i.s.s.	1204	99	Martin & Marrquand, Cardiff
Renalder, iron s.s.	2126	240	W. Thomson&Co., Leith
Alverson, iron s.s.	1368	130	Osborn & Wallis, Cardiff
Katie, iron s.s.	2536	240	C. H. S. Schltz, Stettin
Mount Hermon, i. s.s.	2504	240	John Smith, Glasgow

Tonnage 19,005; nominal H.P. of engines, 2059.

WM. DENNY & BROS., Dumbarton.

Ravenna, steel s.s.	3340	3500	P. and O. Co.
Plucky, i. screw tug	81	250	Otago Towing Co.
Trident, steel p.s.	719	800	Lloyd's Argentine N. Co.
Diana, steel p.s.	519	500	Do.
Booldana, steel s.s.	2823	1800	British India Co.,
Bhundara, steel s.s.	2899	1800	Do.
Kerbela, twin s.s.	1937	1100	Do.
Bancoora, steel s.s.	2899	1850	Do.
Kangra, s.s.	1937	1100	Do.
*a*Ngawoon, twin s.s.	203	300	Irrawaddy Flotilla Co.
*a*Noukmyee, twins .s.	203	300	Do.
*a*Thooreah, steel p.s.	552	1000	Do.

Gross tonnage, 18,112; indicated H.P., 14250.

a Steamers marked thus were taken down, and shipped to their destination in pieces.

MACMILLAN & SONS, Dumbarton.

Name and Description of Vessel.	Gross tonnage.	Indicated H. P. of Engines.	Owners.
Jorge Juan, s.s.	819	780	Olano, Larrinago & Co.
Eleanor, s.s.	819	780	Do.
Corebo III., s.s.	711	550	E. A. Piaggio
Diolibah, s.s.	1606	1100	C. A. Verminck
Persian Monarch, s.s.	3976	2700	Royal ExchgeShipngCo. and J. Paton, jun., & C.,
Egyptian Monarch, s.s.	3976	2700	Do. Do.
Buckhurst, s.v.	1908	—	W. R. Price & Co.

Tonnage, 13,815; indicated H.P. of engines, 8620.

D. & H. HENDERSON & CO.

Hispania, s.s.	3189	1340	Henderson Brothers
Ivanhoe, p.s.	382	1785	Firth Coal SteamPkt.Co.
Vanduara, yacht	87	—	John Clark, Paisley
Cynthia, s.s.	2152	1665	Donaldson Brothers
Titania, s.s.	2152	1665	Do.
Franklin, s.s.	730	790	Spencers Gulf Steamship Co., Limited
Barge "shipped"	83	—	H. B. Huges, Adelaide
Express s.s.	300	500	Henderson Brothers.
Roumania, s.s	3366	1340	Do.

Tonnage 12,341; indicated H.P. of engines, 9085.

SCOTT & CO., Greenock.

Cyclops, s.s.	2300	2000	Messrs.Holt&Co.,L'pool
Bellerophon, s.s.	2300	2000	Do. Do.
Dragut, s.s.	550	500	Compagnie Gen. Trans.
La Valetta, s.s.	550	500	Do.
Mustapha Ben Ismail, s.s	550	500	Do.
Hoihon, s.s.	1400	1100	Swire & Sons, London.
Pakhoi, s.s.	1400	1100	Do.
Keelung s.s.	1400	1100	Do.
Tamsui, s.s'	1400	1100	Do.

Tonnage, 11,850; indicated H.P., 9900.

A. & J. INGLIS, Partick.

Huzara, steel s.s.	2078	1250	British India
Francisco Reyes, s.s.	902	550	Francisco Reyos.
Charles Quint, s.s.	1893	2300	Compagnie Gen. Trans.
Ville de Madrid, s.s.	1893	2300	Do.
Fournel, s.s.	2067	1250	Do.
Camorta, s.s.	2100	1250	Gray, Dawes & Co.

Tonnage, 10,735; H.P., 8900.

Besides this the firm engined the Enterprise, of 1600 H.P., for the Dundalk Steam Packet Company; and the Duke of Leinster, with compound engines of 1600 H.P., belonging to the Dublin and Glasgow Steam Packet Company.

LONDON AND GLASGOW IRON SHIP BUILDING AND ENGINEERING COMPANY.

Humber, s.s.	2372	350	Royal MailStmPakt.Co.
Donato, s.s.	850	100	Line de Vapor Serra
State of Nebraska, s.s.	4000	650	State Steamship Co.
Glenfruin, s.s.	3100	550	M'Gregor, Gow & Co.

Tonnage, 10,322; nominal H.P. of engines, 1650.

RUSSELL & CO., Port Glasgow.

Taramang, s.s.	1300	130	Carson & M'Ilwraith
Konoowarra, steel s.s.	1300	130	Do.
Konneruka, steel s.s.	500	100	Illawarra Steamship
Harley, s.s.	455	85	James Harley
Firth of Dornoch, s.v.	950	—	Spencer & Co., Glasgow
Firth of Cromarty, s.v.	950	—	Do
Southfield s.v.	950	—	Renton & Co., Glasgow
Mandalay, s.v.	950	—	W. &J.Crawford,G'nock
Wigtownshire, s.v.	950	—	Thomas Law, Glasgow
Berwickshire, s.v.	950	—	Do.
Janet M'Neil, s.v.	950	—	Brown&Watson,Glsgow

Tonnage, 10,205; nominal H.P. of engines, 445.

AITKEN & MANSEL, Whiteinch.

Pharos, s.s.	2300	1500	J. Moss & Co., L'pool
Alene, s.s.	2100	1500	Atlas S.S. Co., L'pool
Marana s.s.	2300	1100	G. Bell & Co., L'pool
Livonia, s.s.	1000	550	James Cormack, Leith
Sikh, s.s.	2300	1500	Gellatly,Hankey, Sewell, & Co., London

Tonnage, 10,000; indicated H.P. of engines, 6,150.
Engines made elsewhere.

H. MACINTYRE & CO., Paisley.

Name and Description of Vessel.	Gross tonnage.	Indicated H. P. of Engines.	Owners.
Scotia, p.s.	300	1200	Capt. W. Buchanan, Glasg
Ivanhoe, s.s.	250	300	W. M'Lachlan, Esq., Glasg
Two steel barges	200	—	Atlas Steam Co., London
Banshee, steel s.y.	20	20	W.B.Forwood,Esq.,L'pool
Glenwilliam,irons.s.	500	350	Wm. Sim & Co., Glasgow
Litoral, iron s.s.	800	500	Torrado-Malero, B-Ayres
Gironde et Garonne, p.s,	300	900	Compagnie Gironde et Garonne, Bordeaux
Warkworth Harbour s.s.	900	500	H. Andrews, Warkworth Harbour
Adeline Schull, s.s.	400	600	Kalckhoff & Schoeller, Ant
Redcastle, s. fy.b.	50	80	H. Stewart, Kissock Ferry
Ellus, s.s.	350	400	D. P. Goudie, Naples
Fiume, s.s.	1700	600	Burrell & Sons, Glasgow
Bittern, s.s.	850	550	Cork Steam Ship Co., Cork
Goody, s.s.	300	200	Eligis Geacopini, Spezia
Sissie, s.s.	200	150	China
Mandarin, s.s.	800	500	China Trade
Lylie, s.s.	800	500	G. Bargate & Co., Barrow
Steam Launch	15	60	A. Chaplin & Co., Cra'st'h'l

Tonnage 8935. Indicated H.P. 7200.

JAMES & GEORGE THOMSON, Clydebank.

Trojan s.s.	3600	3800	Union S. S. Co. (Limited), Southampton
LakeManitoba,s.s.	3300	2500	Canada S. Co. (Limited.), Liverpool
Duchess of Edinburgh steel p.s.	1000	2800	South-Eastern Railway Co.

Tonnage 7900; indicated H.P. of engines, 9100.

CHARLES CONNELL & CO., Whiteinch.

Toronto, s.s.	3280	375	Dom. and Miss. S.S. Co. (Limited), Liverpool
Ottawa, s.s.	3712	500	Do. Do.
Diana, s.v.		750	H. Barton & Co., Glasgow

Tonnage, 7742; nominal H.P. of engines, 875.
Engines built elsewhere.

CAIRD & CO., Greenock.

Rohilla, s.s.	3463	3450	P. & O. Stm. Navi'gn Co
VilledeBarcelonas.s	1881	2300	Compagnie General Trans'
Kleber s.s.	1883	2300	Do.

Tonnage, 7227; indicated H.P. of engines, 7050.

BARCLAY, CURLE, & CO., Whiteinch.

Toledo, steel s.s	1171	535	J. Currie & Co., Leith
Argo, s.v.	1561	—	A.&J.Carmichael&Co.,Gk.
Adjutant. s.s.	2275	1098	Seater, White, & Co., Leith
PrincessBeatrice,p.s	221	394	S. and I.of Wight S.P.Co.
Petrel, s.l.	167	200	J. Steel & Sons, Glasgow
Phasis, s.v.	1564	—	A.&J.Carmichael&Co.,Gk.

Tonnage, 6959; nominal H.P. of engines, 2227.

BLACKWOOD & GORDON, Port-Glasgow,

Billiton, s.s.	336	400	Lee Keng Yong, Singapore
Valencia, steel s.s.	1355	675	R. Henderson & Son, B'last
Adrea, steel s.s.	1284	650	Adriatic Steam. Navi'gn Co.
Deak, steel s.s.	1232	666	Do.
Inchgarvie, s.s.	51	4	W. Arrol & Co., Glasgow
Otter, s.s.	287	150	Cunard Co. (Ltd.), L'pool
—— an anchor boat	—	200	J. King & Co., Calcutta
Santarem, twin s.s.	680	650	Amazon Stm. Navig'n Co.
Macapa, twin s.s.	680	650	Do.

Tonnage 6105; nominal H.P. of engines, 3881.

R. NAPIER & SONS, Govan.

Stanley, store vessel	366	365	British Government
Parisian, s.s.	5500	6000	J. & A. Allan

Tonnage, 5866; indicated H.P. of engines, 6365.

HENRY MURRAY & CO., Port-Glasgow.

Ardandhu, iron s.s.	1189	1100	Maclaren, Crum, & Co., Glasgow
Ardanbhan,irons.s.	1174	1100	Do.
Valencia, iron s.s.	570	450	Goodyer & Co., Liverpool
Rio Branco, ironp.s.	902	1000	Do. Do.
Barge, iron	70	—	National Brazilian Steamship Co., Rio de Janeiro
Paddle steamer, steel	80	65	Do. Do.
Barge, steel	80	—	Do. Do.
Barge, steel	80	—	Do. Do.

Tonnage, 4145; indicated H.P. of engines, 3715.

DOBIE & CO., Govan.

Name and Description of Vessel.	Gross tonnage.	Indicated H.P. of Engines.	Owners.
Jeune Amiral, s.s.	518	—	——
Julieta, s.s.	498	—	——
Norfolk, steel s.s.	1758	—	——
Rhenaind, s.s.	1900	—	——

Tonnage, 4674. Engines constructed elsewhere.

WM. HAMILTON & CO., Port-Glasgow.

George Moore, s.s.	910	550	——
Pearl, s.s.	352	350	——
Bessie Morris, s s.	1780	900	——

Tonnage, 3042; indicated H.P. of engines, 1800.

CUNLIFFE & DUNLOP, Port-Glasgow.

Siren steam yacht	200	60	Jas. Coats, jun., Ferguslie
Architect, s.s.	2000	200	J. & T. Harrison, L'pool
Amy steam yacht	600	100	N. B. Stewart, Torquay

Tonnage, 2808; nominal H.P. of engines, 360.

MURDOCH & MURRAY, Port-Glasgow.

Miramar, s.s.	1190	495	Raeburn & Verel
Leda, yacht	701	12	David Lairdlaw
Onward, s.s.	177	390	The Great Northern S.S. Fish Carrying Co.
Progress, s.s.	177	390	
Vigilant, s.s.	177	390	
Speedwell	177	390	
Thraciar, s.s.	864	465	J. & J. M'Farlane
Romeo, s.s.	—	390	Marquis de Capo

Tonnage, 2832; indicated H.P. of engines, 2051.

LOBNITZ & CO., Renfrew.

Vladivostock, s s.	1365	800	Russian
Kamtchatka, s.s.	1365	800	Eastern Agency Co.
Launch (steel), screw	25	20	Foreign

Tonnage, 2730; indicated H.P. of engines, 1600.

NAPIER SHANKS, & BELL, Yoker.

Ferry steamer, screw	20	20	Belfast Commissioners
Soto, screw	1038	430	J. Roca & Co.
Ulloa, screw	430	381	——
Allowrie (steel), t.s.	504	650	Steam Navigation Co.

Tonnage, 2625. Engines built elsewhere; nominal H.P., 1550.

W. SIMONS & CO., Renfrew.

Ballycotton, s.s.	1100	600	ClydeShippingCompany
Lee, s.s.	1600	1000	City of Cork StmshipCo.

Tonnage, 2700; indicated H.P., 1600.

R. STEEL & CO., Greenock.

Forrara, s.s.	1211	120	Leith, Hull, & Hamburg Steam Packet Co.
Catarina, steam yacht	600	112	J. Houldsworth, Coltness.

Tonnage, 1811. Nominal H.P. of engines, 232.

JNO. REID & CO., Port-Glasgow.

3 iron steam yachts	284	—	——
1 steel barque	1245	—	——

Tonnage, 1529; indicated H.P., 200.
Four vessels building. Aggregate tonnage, 2900.

CAMPBELTOWNSHIP BUILDING CO.

Alan MacDonnell, s.s.	200	33	Newry Saltworks Co.
Redland, s.s.	180	30	M. Whitwell&Son, Brstol
Dunbeath Castle, s.s.	200	38	J. Henderson&Co., Wick
Tyne, s.s.	900	85	Fisher, Renwick, & Co., Newcastle-on-Tyne.

Tonnage, 1480; nominal H.P. of engines, 186.

THOS. SEATH & CO., RUTHERGLEN.

Vagliano A, twin s.b.	276	200	Vagliano Bros., London
Vagliano B, twin s.b.	276	200	Do. Do.
Wallace Brothers, s.s.	40	150	Wallace Bros., London
Jasper, s.s.	279	300	W. Robertson, Glasgow
Ganges, steam launch	15	50	J. Finlay & Co., Glasgow
Hoogley, steam launch	15	50	Do. Do.
Olderfleet, s.s.	213	250	H. Smylie, Paisley
Glen Etive, s.s.	45	80	J. Murray, Taynuilt
Irrawaddy, stm. launch	20	70	P. Henderson & Co., Glasgow
Six small cargo barges	210	—	Wallace Bros., London

Tonnage, 1389; nominal H.P. of engines, 1350.

FULLARTON & CO., Paisley.

Name and Description of Vessel.	Gross tonnage.	Indicated H.P. of Engines.	Owners.
No name, s.l.	10	25	Foreign
Westonia, s.y.	150	120	W. C. Dawson, Esq.
Cambrian, s.s.	500	280	J. & J. M'Farlane.

Tonnage, 660; indicated H.P., 425.

CAMPBELL & CO., Abbotsweb Shipyard, Glasgow.

Elfrida, s.s.	500	350	R. C. Colvil & Co. Glasgow

Tonnage, 500; indicated H.P. of engines, 350.

ABERCORN SHIPBUILDING CO., Paisley.

No name, i.s.t.	46	—	For Roumania.
Do., i.s.y.	16	—	For India.
Do., 6i.b.&1 p.,	270	—	For South America.

Tonnage, 332.

BARR & SHEARER, Ardrossan.

Heather Bell, s.	117	—	Prov. Barr, Ardrossan.
Willie Glen, 3-m.s.	140	—	Wm. Glen, Govan.

Tonnage, 257.

TROON SHIPBUILDING CO.

Scotia, b.	173	—	Thomas Steele, Ayr.

Tonnage, 173.

WM. SWAN & CO., Maryhill.

Gladstone, barge	105	—	Clyde Shipping Co.

JOHN MACADAM, Yacht Builder, Govan.

Nora	5	—	Messrs. Allan, Glasgow.
Steam yacht	15	—	Mr. Brannagan, Glasgow
Two small yachts	30	—	——

Tonnage, 50.

GENERAL ABSTRACT.

Name.	Steam Vessels.	Sailing Vessels.	Indicated Horse-Power.	Gross Tonnage.
John Elder & Co.	17	0	38,124	32,775
A. Stephen & Sons	9	0	17,500	19,005
Denny & Brothers	12	0	14,250	18,112
Macmillan & Sons	6	1	8,620	13,815
D. & W. Henderson	8	1	9,085	12,341
Scott & Co.	9	0	9,900	11,850
A. & J. Inglis	6	0	8,900	10,735
London & Glasgow Co.	4	0	9,900	10,322
Russell & Co.	4	7	3,000	10,201
Aitken & Mansel	5	0	6,150	10,000
H. Macintyre & Co.	19	0	7,200	8,935
J. & G. Thomson	3	0	9,100	7,900
C. Connell & Co.	2	1	6,500	7,742
Caird & Co.	3	0	7,050	7,227
Barclay, Curle, & Co.	4	2	6,500	6,959
Blackwood & Gordon	8	1	3,881	6,105
R. Napier & Sons	2	0	6,365	5,866
Duncan & Co.	6	2	3,000	5,500
Dobie & Co.	4	0	4,000	4,674
H. Murray & Co.	8	0	3,715	4,145
R. Chalmers	4	1	2,500	3,500
W. Hamilton & Co.	3	0	2,800	3,042
Cunliffe & Dunlop	3	0	2,900	3,000
Murdoch & Murray	7	0	2,952	2,832
Lobnitz & Co.	2	0	1,600	2,730
W. Simmons & Co.	2	0	1,600	2,700
Napier, Shanks, & Bell	5	0	1,550	2,625
Steel & Co.	2	0	1,500	1,811
J. Reid & Co.	3	1	200	1,529
Campbeltown Company	4	0	1,300	1,480
Thos. Seath & Co.	9	6	1,350	1,389
Fullarton & Co.	3	0	425	660
Campbell & Co.	1	0	350	500
Abercorn Company	9	0	300	332
Barr & Shearer	0	2	—	257
Troon Company	0	1	—	173
W. Swan & Co.	0	1	—	105
J. Macadam	2	2	—	50
	227	31	204,187	242,774

COMPARATIVE STATEMENT.

	1877. Tonnage	1878. Tunnage	1879. Tonnage	1880. Tonnage
Napier & Sons	12,334	3,111	7,054	5,866
Stephen & Sons	10,673	13,682	16,305	19,005
Macmillan & Son	11,477	14,172	13,518	13,815
Aitken & Mansel	10,097	5,200	2,009	10,000
Barclay, Curle, & Co. ...	9,545	20,707	5,546	6,954
Denny Brothers	7,883	22,048	16,236	18,112
London & Glasgow Co. ...	7,229	12,061	4,400	10,322
John Elder & Co.	7,704	18,247	16,895	32,775
Birrell, Stenhouse, & Co. ...	6,723	5,602	3,077	—
Dobie & Co....	6,686	7,408	3,293	4,674
J. & G. Thompson	5,759	12,600	12,200	7,900
Duncan & Co.	5,520	2,500	2,050	5,500
Scott & Co.	5,093	3,000	7,083	11,850
A. & J. Inglis	4,894	7,421	4.170	10.735
Connell & Co.	4,788	10,479	9.530	7,742
Wingate & Co.	4,789	3,831	650	—
H. Murray & Co.	4,492	2,188	4,312	4,145
Simons & Co.	4,210	4,420	5,150	2,700
A. & W. Henderson ...	4,290	6.825	3,306	12,314
Steel & Co.	3,949	3,793	2,000	1,811
Russell & Co.	3,489	6,883	4,200	10,201
Hamilton & Co.	3,370	1,460	3,461	3,042
Blackwood & Gordon ...	2,647	2,550	3,636	6,105
Caird & Co.	3.317	9,000	6,800	7,227
Lobnitz & Co.	2.177	3,433	1,550	2,730
Murdoch & Murray... ...	2,126	2,951	1,932	2,832
Macintyre & Co.	2.050	4,213	5,475	8,935
Cunliffe & Dunlop	31,767	3,515	2,115	3,000
J. E. Scott	1,557	2,807	500	—
Swan & Co.	835	530	—	105
Fullarton &Co.	806	573	226	660
Abercorn & Co.	681	320	128	332
Scott & Macgill	576	110	300	—
Seath & Co.	—	—	1,037	1,389
*Campbell & Co.	—	—	—	500
Barr & Shearer	—	—	220	257
Troon Co.	—	—	185	173
J. Macadam	—	—	—	50
Napier, Shanks, & Bell ...	—	—	485	2,625
R. Chalmers & Co.	—	—	400	3.500
Campbeltown Co.	—	—	1,100	1,480
John Reid and Co.	—	—	260	1,529
	163,472	215,640	173,820	242,774

Total increase for the year; 68,954.

No returns have been received from Messrs. R. Duncan & Co., Port-Glasgow, and R. Chalmers, Dumbarton; but as near as we can ascertain their output is as under :—D. Duncan & Co., 8 vessels, with a tonnage of 5500; and R. Chalmers & Co., 5 vessels, with a tonnage of abont 3500.

VESSELS BUILDING.

The following vessels are presently being built on the Clyde, some of the larger ones being well advanced :—

NORTH GERMAN LLOYD'S—Messrs. John Elder & Co., for Atlantic service, the Elbe. 4500 tons. Indicated horse power, 5400.

GUION LINE—John Elder & Co., for Atlantic serviee, the Alaska. Length, 500ft.; breadth, 50ft.; 6250 tons. Indicated horse power, 10,000.

STATE LINE—London and Glasgow Shipbuilding and Engineering Company, same lines as State of Nebraska.

CUNARD LINE—Liverpool and New York—Aurania, by Messrs. J. & G. Thomson, Clydebank, same line as Servia. Length, 500ft.; breadth, 50ft.; depth, 45ft.; gross tonnage, 7000. Indicated horse power, 8500. American trade—Messrs. J. & G. Thomson—Pavonia. Length, about 400ft.; breadth, 42ft.; depth, 36ft. Gross tonnage, 5000. Indicated horse-power, 4500. Liverpool and New York—Messrs. J. & G. Thomson—Servia. Length, 530ft.; breadth, 52ft.; depth, 46ft. Gross tonnage, 8500. Indicated horse power, 11,000. American trade—Catalonia. Messrs. J. & G. Thomson. Length. 450ft.; breadth, 44ft.; depth, 38ft. Gross tonnage, 5900. Indicated horse power, 5000.

CITY LINE (G. Smith & Sons, Glasgow)—Messrs. Charles Connell & Co., Whiteinch. Length, 400ft.; breadth, 42ft.; depth, 30½ft. Gross tonnage, 4000. Indicated horse power, 3500.

ANCHOR LINE—Glasgow and New York. Messrs. D. & W. Henderson, Partick. About 400ft. long, 38ft. broad, 35ft. deep, and 3800 tons Gross.

GLEN LINE—The London and Glasgow Engineering and Iron Shipbuilding Company. Tonnage about 3000. Indicated horse power, 2900.

NEW COMPANY—Messrs. Dobie & Co., Govan. Twin screw-steamer. Length, 425 ft.; breadth, 44 ft.; depth, 38 ft. Tonnage, about 4300.

MONARCH LINE—Messrs. M'Millan & Co., Dumbarton. Tonnage, about 4300.

PACIFIC COMPANY—Messrs. Napier & Sons, Govan. Tonnage, 3500 (2 vessels).

DONALD CURRIE LINE—John Elder & Co. Drummond Castle, 3700 tons. Indicated horse-power, 3200.

PENINSULAR AND ORIENTAL (2)—Messrs. Caird & Co., Greenock. Tonnage of one about 4000, and of the other about 5000 tons.

UNION LINE (2)—J. & G. Thomson, Clydebank. Length, 365 ft.; breadth, 42 ft. 6 in.; depth, 32 ft. 6 in.; 3554 tons. Aitken & Mansel—Tonnage, 3650. Indicated horse-power, 3700.

BRITISH INDIA STEAM NAVIGATION CO.—W. Denny Bros., Dumbarton. Length, 320 ft.; breadth, 40 ft.; depth, 28 ft. 6 in.; 2000 tons. Messrs. A. & J. Inglis, Patrick. Length, 400 ft.; breadth, about 43 ft.; depth, 34 ft. 6 in. Gross tonnage, about 4000.

PACIFIC STEAM NAVIGATION CO.—Messrs. Dobie & Co. 3500 tons.

ORIENT LINE—John Elder & Co.—Austral, 5500 tons. Indicated horse-power, 5800.

STOOMVAART MAATSCHAPPY & CO., AMSTERDAM—John Elder & Co. 2800 tons. Indicated horse-power, 2000.

RUSSIAN GOVERNMENT—Messrs. John Elder & Co. Engines of 7000 indicated horse-power for the warship Peter the Great.

CLYDE LINE (Donaldson Bros.)—Barclay, Curle, & Co. Two vessels.

BURNS' LINE—Scotland and Ireland. Barclay, Curle, & Co. Two Steamers. Scotland and Ireland—Blackwood & Gordon, Port-Glasgow.

SHIRE LINE (David Law)—Messrs. Napier, Shanks & Bell. Sailing vessel of about 1500 tons.

AITKEN AND LILBURN LINE—Messrs. Barclay, Curle, & Co. Two four-masted ships about 2000 tons.

CLYDE SHIPPING CO.—Messrs. W. Simons & Co., Renfrew. Steamer of 1200 tons.

BRITISH GOVERNMENT—Messrs. Robert Napier & Sons. Two war vessels of about 4000 tons each.

NEW ZEALAND GOVERNMENT—Messrs. W. Simons & Co., patent hopper dredger of 1800 tons.

WATSON LINE (Glasgow)—H. Murray & Co., Port-Glasgow, four-masted barque, 1900 tons.

SCOTT & CO., Greenock, screw-steamer of 3400 tons.

Besides the above, the Clan Line (Cayzer, Irvine, & Co., Liverpool, London, and Glasgow) are getting four fine new steam vessels built for their new trade, and a portion of the contract, it is said, has gone to Messrs. Alex. Stephen & Sons, Linthouse, and the other to Dumbarton, Messrs. Stephen & Sons are also building for an Italian firm, and Messrs. A. & J. Inglis, besides their British-Indian contract, have work on hand for a French company. There are about fifty vessels presently under construction on the Clyde of over 3000 tons each.

NEW THAMES FIRE RAFT.—The trial of a new steamtug and raft, built to the order of the Board of Works for the use of the Metropolitan Fire Brigade, took place lately on the Thames. Captain Shaw, C.B., Mr. Bernard Shaw, Mr. W. S. Baker, representative of the Board of Works, and several members of the Metropolitan Fire Brigade were present. The raft and tug have been designed and built by Mr. Edward Hayes, C.E., engineer and steamtug builder, of Stony Stratford, who has produced a raft of great strength and light draught to carry a steam fire-engine. The tug is one of the builders' ordinary type, 60 feet in length and 10 feet in beam, which is handy in manœuvring with the raft. The speed attained is considerably in excess of any hitherto reached in similar experiments.

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* New firm. The yards of Messrs. Wingate & Co., J. E. Scott, and Birrell, Stenhouse, & Co. are presently closed.

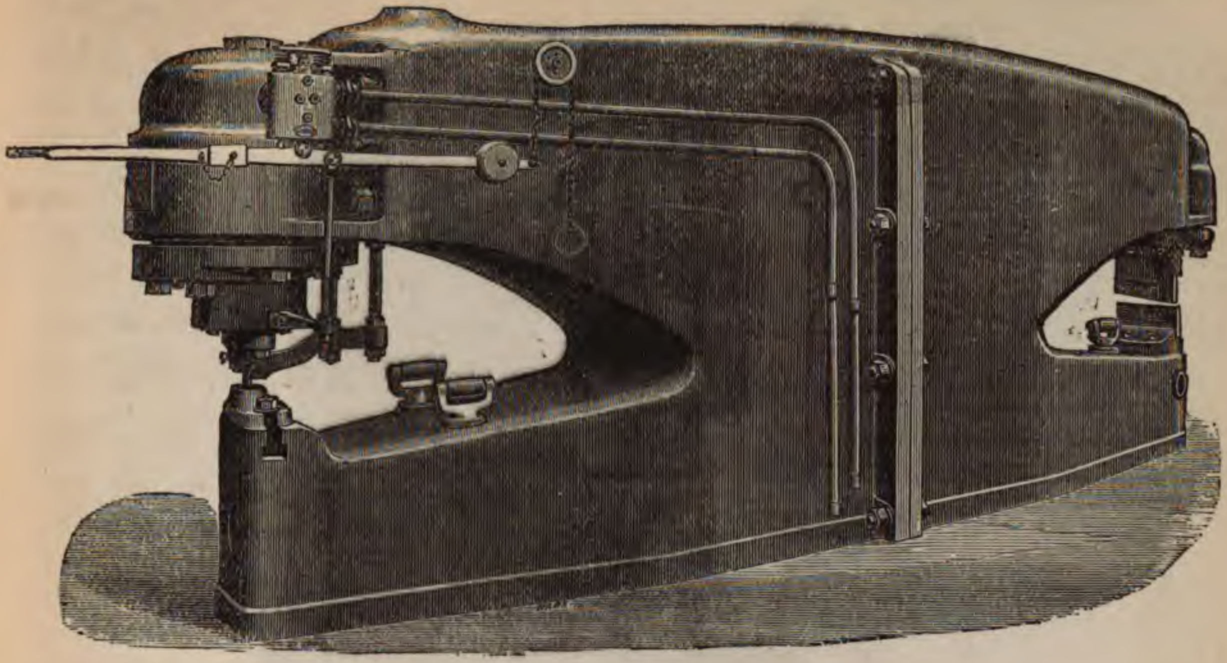


FIG. 7.

THE APPLICATION OF HYDRAULIC MACHINERY TO SHIP-BUILDING.

IN our last number we considered the advantages likely to accrue from the adoption of hydraulic machinery when applied to the rivetting of the various parts of iron or steel ships. We will now briefly describe some of the special tools used for this purpose in ship-yards fitted up on Mr. Tweddell's system.

Referring to the small illustrations on pages 238 and 240 in our last, the first shows a compact form of hydraulic rivetter conveniently suspended for rivetting up hold beams. In many ship-yards upwards of 1,500 rivets are thus put in per day by one machine. In some cases the machine is stationary, and the beam to be rivetted is run underneath it; but more generally the beam is laid on fixed supports and the rivetter run along on an overhead gantry. The right hand figure on page 238 shows a similar machine, but suspended conveniently for rivetting frames and floors. It will be observed that no pipes hang about the machine, the pressure water entering by the curved suspending bar as indicated by a small arrow. The cylinder is below the frame being rivetted, and the hot rivets are dropped into their holes from above. This saves much time. The machine is also free to oscillate on a trunnion at the point where the suspending gear joins the steel body. These machines as shown in the wood-cut on page 24 can also be worked if desired with the cylinder uppermost. Different modes of procedure are used for rivetting frames and floors. In some ship-yards travelling cranes, of the type illustrated on page 239, are used. On this illustration a portable rivetter of a different type is shown; but similar machines to those we have just been describing can, of course, be attached to the hydraulic lift in connection with the travelling crane. Assuming then that the keel is placed on the blocks, and the frames, floors, and reverse bars are laid across the inner end of the keel ready for rivetting up, two travelling cranes are placed at the head of the berth on either side of the keel. Room is left between them for the frames to pass through, and as the cranes are free to revolve all round, and the travelling monkey carrying the hydraulic-lift and rivetter can move in and out along the jib, any part of the frames or floors can be reached without moving them, or breaking and making any joints in the pipes. It should be mentioned that the hydraulic-lift also serves to convey the pressure water to the machine, thus answering a double purpose, and avoiding all the trouble and annoyance of pipes hanging about in the way of the men. The lifts are also useful for many other purposes. In other cases again the cranes carrying the rivetters are made stationary; in which case a form of crane similar to that illustrated on page 241 in our last issue is employed. The crane is, however, attached to a strong wooden pillar instead of to a wall, as shown on the wood-cut. These posts are placed on either side of the keel, as already described in reference to the travelling cranes. The advantage claimed for the former plan is that the whole apparatus is easier removed from one berth to

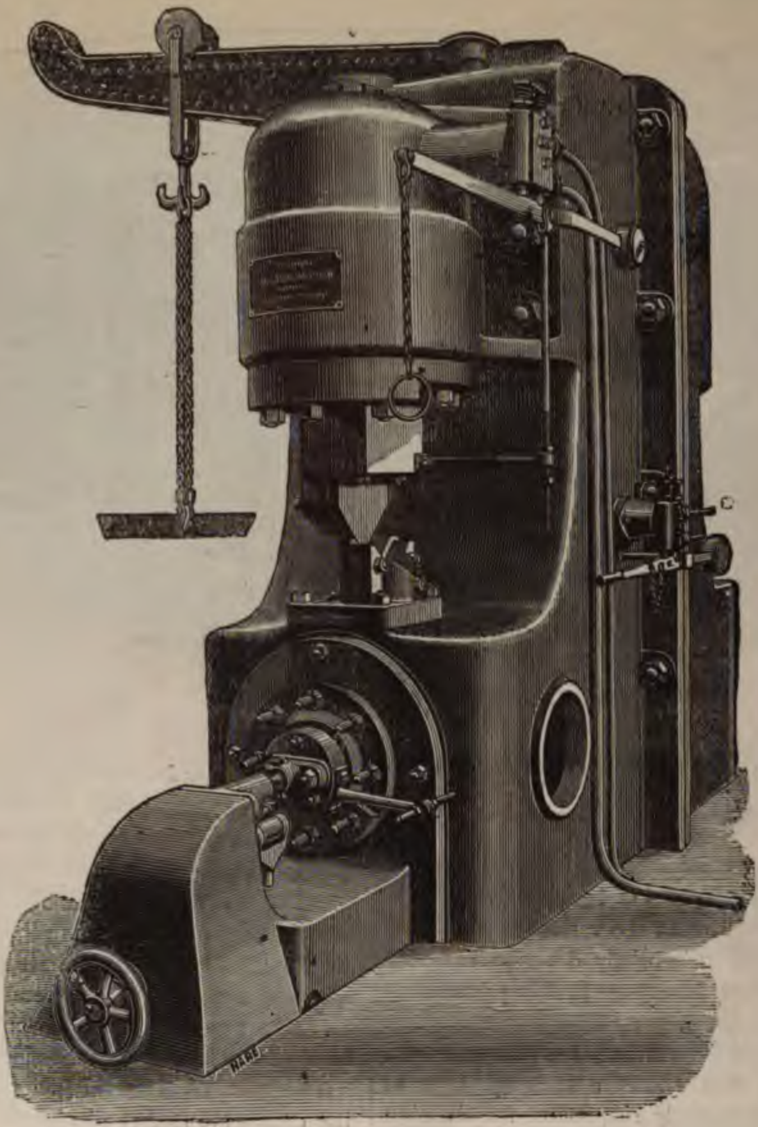
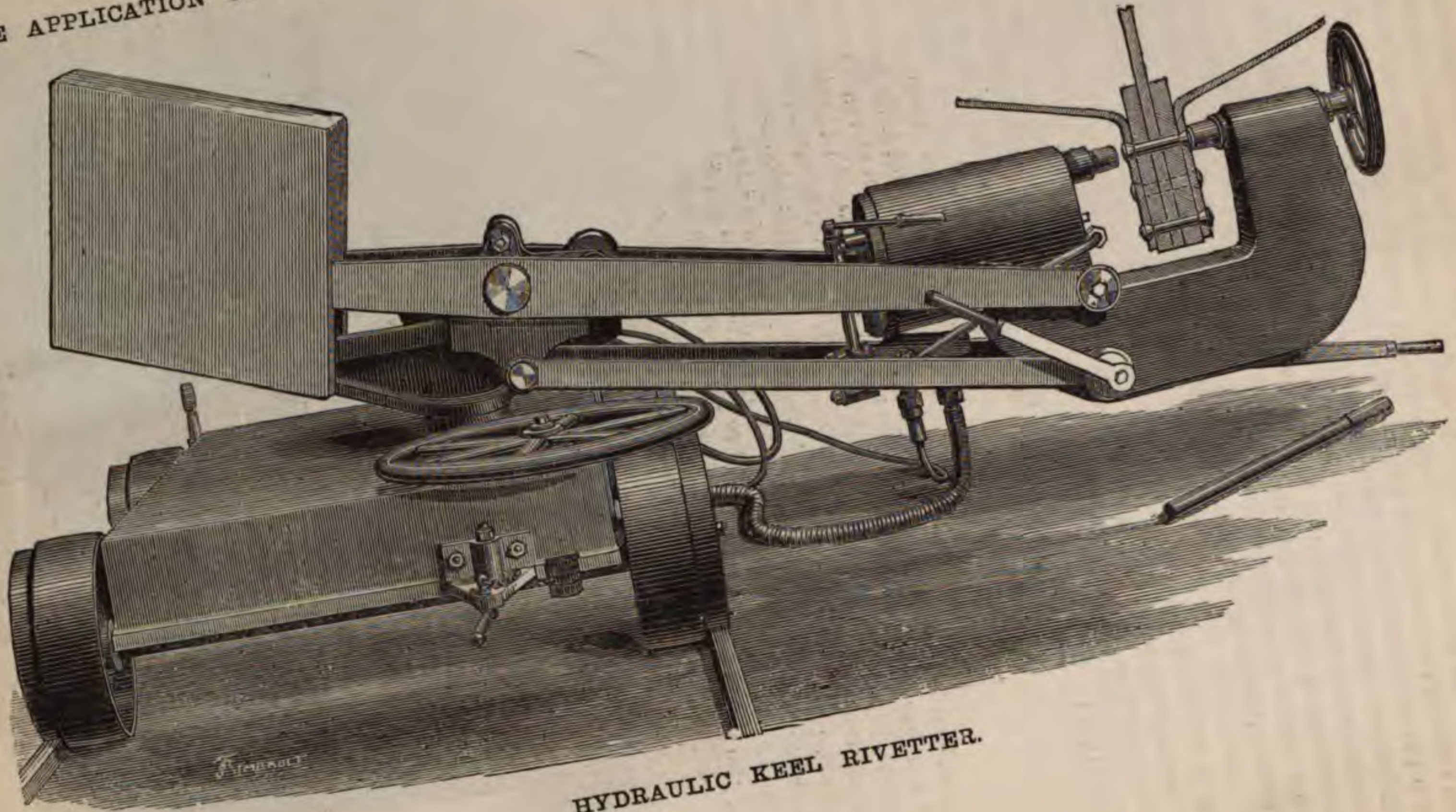


FIG. 8.

another. In many yards on the Clyde one crane and rivetter does all the rivetting as fast as the men can put the frames together. In some cases, as at Messrs. Macmillan's, for instance, one rivetter used in connection with a fixed crane 45 feet rake can do all the rivetting for the frames of a 4,000 ton ship. The rivetter in this case is of the Fielding type. We shall describe this later on, when we treat of the rivetting of floors, stringers, etc., where long gaps are required. In another ship-yard, where the steel frames are rivetted up in sections, one of the small rivetters, already illustrated, is keeping three vessels supplied with frames. However it is found that every ship-yard has to be fitted up to suit its special conditions of working, which depend upon several considerations, such as the room available, shape of the yard, and the class of vessel being built. At the Barrow Ship-building Company's Works, where there is ample room, and the very largest class of vessels are built. Mr. Humphrys has carried an overhead railway across the yard at the head of the berths; on this the cranes carrying the rivetters run, and the frames as they pass under this railway are commanded by the rivetting machines and thus rivetted up. This avoids the trouble of removing the cranes from berth to berth, and when the yard admits of it, is a very good arrangement. It is at the Barrow yard (amongst others), that the keel rivetting machine, illustrated in this number has proved so successful. The whole of the keel of the *City of Rome* has been rivetted by this machine, and is a very fine piece of work. The rivets are 1¼ inches diameter and 9 inches long, and as may be imagined no handwork could do such work

THE APPLICATION OF TWEDDELL'S SYSTEM OF HYDRAULIC MACHINE TOOLS TO SHIPBUILDING.



HYDRAULIC KEEL RIVETTER.

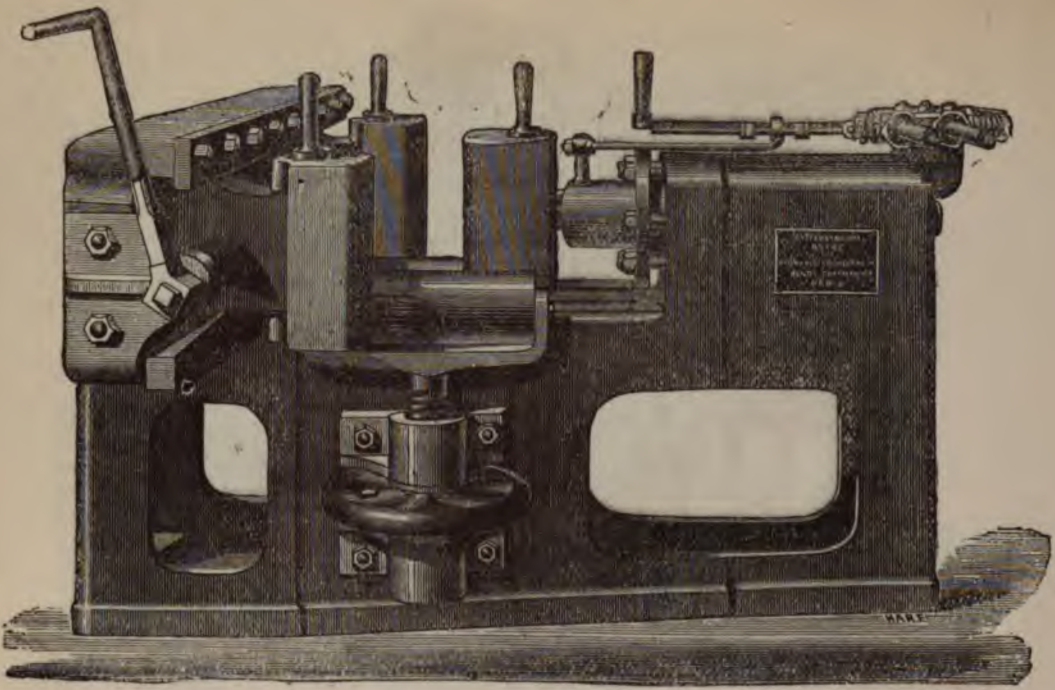


FIG. 9.

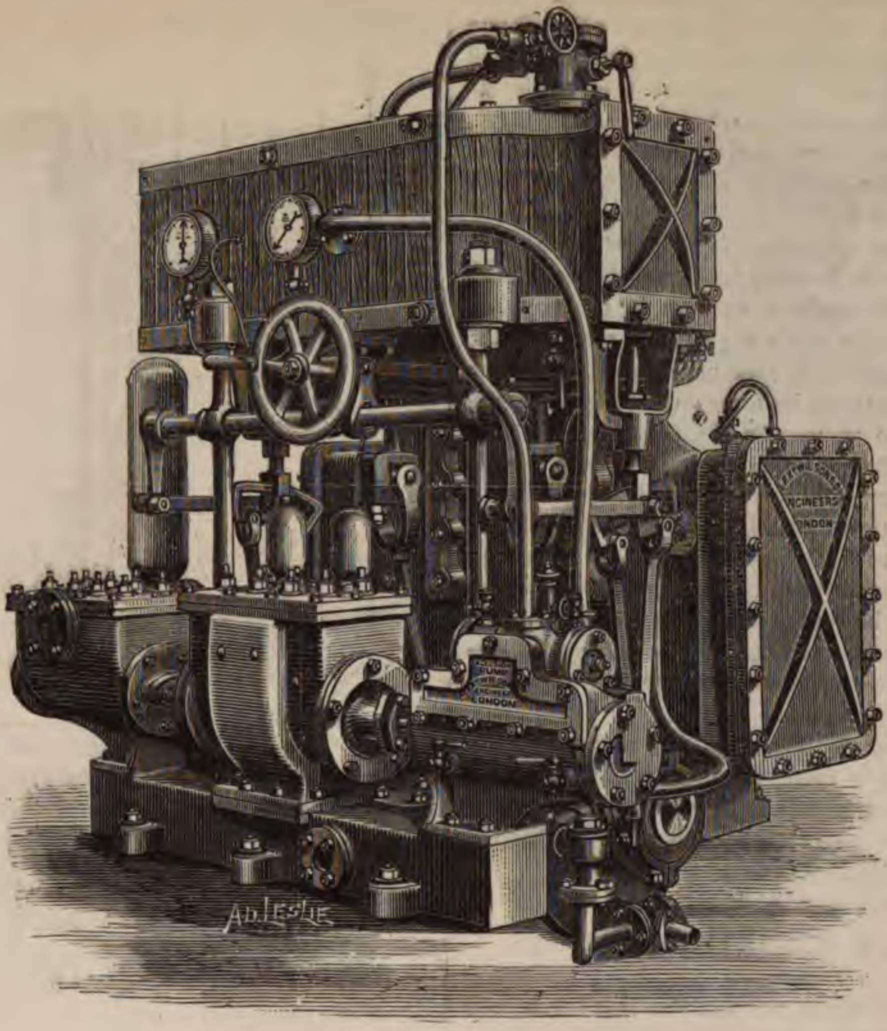
properly. As it is, no boiler work is more closely laid up. It may be in the recollection of many of our readers the interest taken during the visit of the Institution of Mechanical Engineers to Barrow last summer in seeing this machine rivetting the keel of s.s *Furnessia* of the Anchor Line. In order to meet many special conditions peculiar to keel rivetting, and to enable the rivet to be well and securely closed, a special type of machine is necessary in order to get it applied in so confined a space as that available under a ship's bottom. The rivetter itself, is carried on rivets oscillating on gudgeons. These latter are fixed to a small carriage, which is itself free to travel, on a turn-table attached to the trolly, which travels down the yard parallel to the keel. The rivetter is a very powerful one, but its weight being counterbalanced, one man can easily adjust it. There are other special applications and designs of rivetting machines which we hope to describe on a future occasion, but before concluding our remarks this month we will describe some of the other applications of hydraulic pressure to machine tools on Mr. Tweddell's system.

The illustration fig. 7 shows an hydraulic punching and shearing machine. This machine has a gap of 60 inches, and can punch $1\frac{1}{4}$ in. holes in $1\frac{1}{4}$ in. plate, or shear $1\frac{1}{4}$ in. thick at that distance from the edge. Fig. 8 shows a very powerful hydraulic machine for shearing up to $6\frac{1}{2}$ by $6\frac{1}{4}$ by $\frac{5}{8}$ in. angle iron, and for punching the same. Fig. 9 shows an hydraulic angle-bending and straightening machine. This machine possesses several valuable features, and is found very useful. One of these is at work at Messrs. Samuda's ship-yard, Poplar. It is one of the smaller size, similar to the one we illustrated; but some of those mentioned are made up to 100 tons power, and deal with the very heaviest steel sections used in the construction of iron-clad vessels. We hope on a future occasion to discuss the relative economy and other advantages of this system as compared with geared machines.

COMPOUND SURFACE CONDENSING SCREW ENGINES.

By Messrs Alex. Wilson & Co., Vauxhall Iron Works, Wandsworth Road, London, S.W.

THESE engines which we illustrate this month, are of a size to which many of our readers are not accustomed; Messrs. Wilson & Co. laying themselves out more especially for the manufacture of engines of a small size, not exceeding 40-horse power. Their high pressure engines, both of the single and double cylinder type are now well known, and for some years past they have been directing their attention to the manufacture of Compound Surface Condensing Engines, as the high pressure engines are found to be very troublesome when working in salt water, so much so that in many cases large tanks of fresh water are



COMPOUND SURFACE CONDENSING ENGINE.

carried in launches. This, however, is a very bungling system of getting over the difficulty, when a condenser can be used, and especially when it can be used in conjunction with a compound engine, ensuring a large saving of fuel, which in most parts of the world is an object to be attained.

Messrs. Wilson & Co. now manufacture these compound engines with the high pressure cylinder as small as 6 in. diameter, and they are now sending them to all parts of the world to be fitted in boats, built of wood, on the other side.

On referring to the engraving it will be seen that the engines are of rather a novel type, so far as regards the manner in which the air and circulating pumps are driven. With few exceptions these pumps are usually driven from the cross-heads of the main engines by levers working over the top of the condenser, at the back of which latter are fixed the pumps. In the engine illustrated it will, however, be seen that the pumps are driven independently of the main engines by a direct acting steam cylinder; the air and circulating pumps being fixed on the same piston rod "tandem" fashion. The valves of the pumps are accessible from the doors on the top sides, without disturbing anything. The valves of the steam cylinder are also easily accessible by the door in front.

The engines are of the usual type of compound engines, but with both valve chest covers to the outside, so that both valves are accessible with the least possible trouble. The cylinders, which are $\frac{\text{9 in. and 18 in. diameter}}{\text{10 in. stroke}}$ supported on one side by the condenser casing, on which are cast the slipper guides for the cross-heads. The front side of the cylinder is supported by turned wrot iron pillars carrying the shaft for the reversing levers, and which are actuated by a wheel and screw. The condenser has brass tubes $\frac{5}{8}$ in. diameter, and gun-metal tube plates with screw glands for the tube fastening.

The great advantage of this type of engine for small sizes is, that at a speed of 200 revolutions the air and circulating pumps would not work satisfactorily if attached to the main engines, and this would be aggravated in rough weather when the engines raced, while should the boiler, from any cause, happen to prime there is less likelihood of a breakage of the air pump rods or levers.

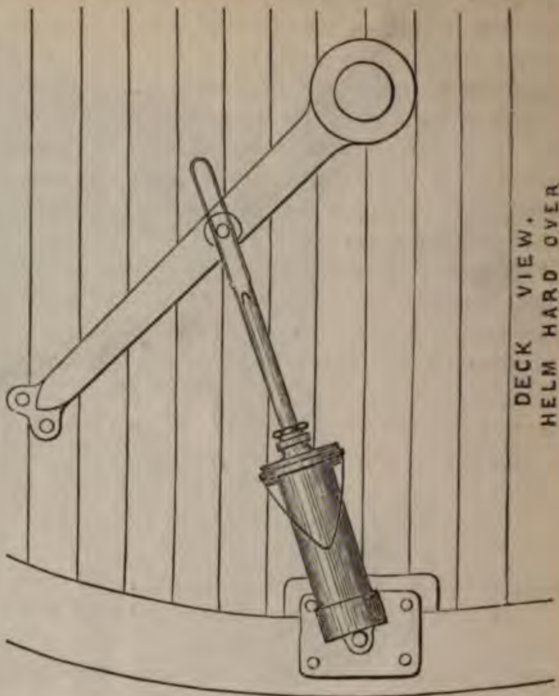
A second great advantage is that as these small engines require to be handled rapidly, this type enables the driver to first obtain a vacuum by the auxiliary engine, and then the main engines are exactly in the same position as a high pressure engine, the steam from the boiler exerting its force on the high pressure cylinder, and the vacuum in the condenser exerting its force on the low pressure cylinder, the engine is then bound to start from any position of the cranks.

The exhaust pipe from the direct acting cylinder communicates with the condenser, but when the engine is fairly under way, by turning a two-way cock the exhaust can be sent at will into the steam chest of the low pressure cylinder, thus obtaining all the advantages of the expansion, and giving an additional power to the main engines.

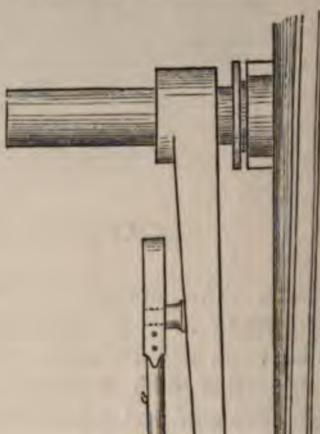
As will be seen by our practical readers all the small details have been carefully worked out and designed with ample strength, while the quantity of materials and the workmanship are quite equal to the best style produced in London.

SAFETY STEERING GEAR.

THE subject of quick and effective steering is now the cause of much invention and improvement in steam vessels. There are many steam-steering gears which we have already illustrated, and which have been already largely applied ; but what we illustrate herewith is a simple auxiliary apparatus to aid the ordinary hand-steering gear. This gear will, we think, be readily appreciated by many who would not go to the extent of putting down more or less complex steam-steering gear. This mechanical steersman will, at any rate, be equivalent to one or two additional hands at the wheel, and will cost nothing in work and very little in maintenance. The apparatus consists of an oscillating cylinder working on a fixed pivot in the keel line of the vessel, and fitted with a strong spiral spring and piston. When the rudder is amidships the cylinder is at what may be termed dead centre, and there is then no pressure on the tiller to turn the rudder to either side. As soon, however, as the helm is moved slightly over, the spring at once comes into play, exerting its maximum effort at first in the position of least mechanical advantage, and as the tension of the spring reduces, the mechanical advantage increases, thus producing a fairly uniform pressure upon the rudder to put it hard over. The apparatus may be checked at "the steady" by the use of a check line on the cylinder, which may engage itself into a shouldered hook in the connecting rod, and so prevent further expansion of the spiral spring.



DECK VIEW.
HELM HARD OVER



SIDE VIEW.
HELM AMIDSHIPS.

This effort of the spring is of very great assistance in putting the helm over quickly, and in steadying the helm when over, conferring the power of two or three men to a single hand. The pressure of the water upon the rudder will bring the helm back to amidships against the pressure of the spring. It is self-acting, and requires little or no attention, as there are only two points to lubricate. It is extremely simple in construction, and consequently cheap, and would not be affected by the vessel shipping a sea.

This apparatus is the patent of J. Davies, 38, Jolliffe-street, Liverpool, and has been in successful operation under sail and steam over a distance of 80,000 miles. It is therefore practically proved to be of great efficiency and value, and we therefore consider it well worth the attention of shipowners as a simple means of increasing the efficiency of steering gear.

WHAT IS THE MOST ECONOMICAL POINT OF CUT-OFF FOR STEAM ENGINES?

By Wm. D. Marks,
Whitney Professor of Dynamical Engineering, University of Philadelphia, Pennsylvania,

PROBABLY no question is more frequently asked, and has hitherto received more unsatisfactory replies from the experts in steam engineering, than what is the most economical point of cut-off for steam engines?

Some writers have recommended that the point of cut-off should be determined by dividing two by the square root of the steam pressure in pounds per square in., although they have not stated their reasons when they stated their facts; others have passed his point over in silence, and still others have endeavoured to determine the point of cut-off, giving the most economical results by many and costly experiments.

When we reflect upon the fact that nearly every man, woman, and child in this country has labouring for it one horse-power in its steam engines, the immense saving derivable from a ready rule for the economical adjustment of the expansion of steam will appear in all its importance, and the writer therefore hopes that the following original investigation and enunciation of a simple rule will prove of much interest and profit to all using steam.

It will at once be perceived that the work done during one stroke of the engine is equal to the mean pressure multiplied by the volume of the cylinder swept through by the piston

Let P = the mean pressure in pounds per square in. (absolute).
,, P_b = the initial ,, ,, ,, ,,
,, B = the back ,, ,, ,, ,,
,, e = the fractional part of the stroke at which the steam is cut off by the valve motion.
,, V = the volume of the steam cylinder.
,, E = the economy.

Now it will further be acknowledged that the economy increases directly as the work done during one stroke and inversely as the steam used during one stroke. Therefore we have

$$E = \frac{PV}{eV} = \frac{P}{e} \tag{1}$$

We have further the well known formula for the mean effective pressure of steam used expansively, supposed to expand according to Marriotte's law—

$$P = e P_b \left[1 + l.\frac{1}{e}\right] - B \tag{2}$$

While this does not accurately represent the law of expansion of steam, it does it with close approximation, for all practical purposes. Substituting the value of P from equation (2) in equation (1), we have

$$E = P_b \left[1 + l.\frac{1}{e}\right] - \frac{B}{e} \tag{3}$$

Differentiating with respect to e, and seeking the maximum, we find it to be

$$e = \frac{B}{P_b} \tag{4}$$

That is, *the fractional part of the stroke giving the most economical point of cut-off for a steam engine equals the absolute back pressure per square inch divided by the absolute initial pressure of the steam per square inch.*

Example.—In a condensing engine, let the gauge pressure = 45 pounds, and the absolute back pressure = 3 pounds.

$$e = \frac{3}{45+15} = \frac{1}{20} \text{ of the stroke.}$$

If the engine be supposed non-condensing, and the absolute back pressure = 15 pounds (1 atmosphere), we have

$$e = \frac{15}{60} = \frac{1}{4} \text{ of the stroke.}$$

If in equation (3) we substitute the value of $e = \frac{B}{P_b}$ we have

$$E = P_b \left[1 + l.\frac{P_b}{B}\right] - P_b = P_b\, l.\frac{P_b}{B} \tag{5}$$

which gives us a comparative estimate of the economy of the condensing and non-condensing engines having the same initial pressures.

Thus, for the non-condensing engine we have

$$E = 2{\cdot}3026\, P_b \log.\frac{P}{B}$$

or

$$E = 2{\cdot}3026 \times 60 \times 0{\cdot}60206 = 83{\cdot}17$$

and for the condensing engine we have

$$E = 2{\cdot}3026 \times 60 \times 1{\cdot}30103 = 179{\cdot}74$$

showing that, when both engines are worked to the best advantage, the condensing engine is more than twice as economical as the non-condensing engine. The writer proposes to add a more exact demonstration in the near future, but engineers will find the above method simple and exact enough for all ordinary practical purposes

SHIPBUILDING ON THE TYNE.

PROPOSED YARD AND WORKS AT SCOTSWOOD.

AN enterprise which promises to prove of great importance to Newcastle has just been entered upon by a firm of iron shipbuilders and engineers at Scotswood. This firm, which consists of three gentlemen, Messrs. Campbell, Macintosh, & Bowstead, have taken from Mrs. Blackett-Ord, of Whitefield House, near Hexham, a long lease of about eight acres of the tract of land at Scotswood, known as the Haughs. Their objects are to commence on this land an iron shipbuilding yard in the first instance, and ultimately also marine engineering works. They have leased sufficient land on which they may proceed at one time with the construction of eight vessels, and also make their own engines. The part of this well-known tract of land that they have obtained is that at the western end, and comprises more than half of the whole. It was in August last, we believe, that this enterprise was first set on foot, and since then the firm have secured the lease, purchased their machinery in Glasgow, and commenced to lay out the foundations of their new establishment. The contract for the erection of the necessary buildings has been given to Mr. Wilkinson, of Leamington, and already a shed for the use of the contractor's men has been nearly finished. Such is the position of a project, the importance of which to the Tyne and to Newcastle cannot be too highly estimated. Previous to the opening of the Spring Bridge there was no possibility of the development of shipbuilding above-bridge, owing to the low bridge presenting an impassable barrier to anything but keels and small steamers. But, since then, commerce has spread its branches more and more up-river until it has given cause for the hope that in time it may flourish there almost as well as it does below bridge. The enterprise of the River Tyne Commissioners, too, sent the dredgers up as far as Scotswood, and to a certain extent removed an obstruction in the shape of King's Meadows. All these improvements have meant a development of the trade in that direction, and one of the chief steps towards that end is about to be taken by Messrs. Campbell, Macintosh, & Bowstead, at Scotswood. The choice of site for such an industry as that contemplated appears to be an excellent one, the land being flat, and with capital river frontage. At high water the river in front of the projected works is 20 feet deep, and when the dredgers have been there it is estimated that there will be a depth of at least 7 feet more. This is ample water in which to launch a steamer of great size, and as the stream here at high tide is about 800 feet wide, there will be room enough and to spare to launch a large vessel at an angle. The site, which is about 200 yards wide and a little more than a quarter of a mile long, is faced by the river on the south, and by the turnpike for Newcastle on the north. It is only about three miles from the centre of Newcastle, and is within a hundred yards of the Carlisle branch of the North-Eastern Railway. With such facilities for transit, and with such a well-adapted river for the purpose, it will be observed that the choice of site is a sagacious one. In course of time, when the works get into full working order, it is estimated that at the Scotswood yard no less than 600 or 700 men will be employed. This, of course, means an increase in the value of land in the neighbourhood, the erection of workmen's dwellings, and, generally, a rapid growth of Scotswood and the western part of Newcastle. The growth of Newcastle has been almost unceasing, but not more rapid in any direction than the west, and the projected works, if carried out to success, will give a great impetus to this development. At present Scotswood is a quiet little town, its population being supported by one or two industries, but a shipbuilding yard and marine engineering works would entirely change the aspect of the place. The site at present has the appearance of a waste tract of land, and its only utility has been the opportunity it has given the lovers of aquatics to watch the operations of the scullers in training. Indeed, Scotswood Haughs are redolent of aquatic associations, for many are the times that hundreds of people have gathered there to see the aquatic celebrities at practice, and thousands have massed there to witness the finish of each great match. But though their sports are indispensable to Englishmen, in this utilitarian age even aquatics must not stop the onward progress of our material wealth. One pleasing feature connected with the project of the new Scotswood firm is their intention, though they have the power to do so, not to remove the boatbuilding establishment of the celebrated firm of Messrs. Swaddle & Winship. The part of the works with which the builders will begin their labours are the furnaces, and it is expected that so advanced will be the work that the first keel will be laid down in February next. Whether the introduction of shipbuilding to Scotswood proves successful or not—the fact that experienced engineers such as those of which the new firm is composed have thought it possible—will turn the attention of others to the upper reaches of the Tyne for sites for new industries. Looking at the project from every point of view, it is one which merits success and the well wishes of all those interested in the welfare of the Tyne as a commercial river. Two of the partners of the new firm are Clyde men, and have been connected with the shipbuilding trade of Glasgow.—*Newcastle Daily Chronicle.*

AN HYDRAULIC SHIP.—Another hydraulic ship has lately been launched in Germany, but, as usual with vessels of the same description, she has failed to attain the speed expected. In these hydraulic ships water taken in through the bottom is expelled at both sides in the line of the keel, and the reaction of the fluid issuing at high speed drives the hull ahead if the water is allowed to escape aft, or astern if it escapes towards the bow. The notion is no new one, for as far back as 1661 an inventor received a patent for propelling vessels by expelling water from their sterns. In 1730 another patent was secured for doing nearly the same thing, and since that time nearly 50 persons have taken out patents for hydraulic vessels. About 10 years ago a vessel called the *Waterwitch*, of 1,279 tons displacement, was built for our Navy, to test a proposed system of hydraulic propulsion, but, though the ship is only of light draught, has good lines, and is fitted with engines 775-horse power, she has never exceeded when at sea a speed of from five to six knots, and has never been trusted out of sight of land. The hydraulic ship lately built in Germany is 110 feet long, 17 feet wide, with a draught of 15½ feet of water, and was expected to attain a speed of 10 knots an hour, but on her trial trip she could barely accomplish nine. She proved, however, to be extremely handy, running close up to a sailing vessel which crossed her course, and then, stopping her way in a moment, turned immediately to starboard.

HER MAJESTY'S SHIP INFLEXIBLE.

AFTER her gunnery trials on the 16th and 17th December, and the trial of her propelling machinery on the 18th (see January No.) the *Inflexible* was taken back into the repairing basin at Portsmouth for the purpose of being completed for sea. Notwithstanding, however, the eminently successful manner in which she passed the crucial ordeal to which she was subjected, the simultaneous discharge of 1,350 lb. of powder and of 5,100 lb. of metal from her three guns—not abeam, as was the case with the *Duilio*, but at 15 and 45 degrees abaft the starboard beam—failing to inflict as much injury to the hull as the vibration from her two-bladed propellers, the *Inflexible* is still doomed to delay. Commenced at Portsmouth on the 24th of February, 1874, and launched by the Princess Louise on the 27th of April, 1876, the monster turret ship might well be supposed to be now almost ready for the pennant. It would be superfluous to inquire into the causes which have hithero retarded her progress. At the time she was designed the *Inflexible* was a complete and adventurous novelty in naval shipbuilding, and at almost every stage of her construction she had been the source of much anxiety and controversy on the part of the Constructive Department. Not only was she the largest turret ship in the service, but she was protected by the thickest armour, armed with the heaviest guns, and was in other respects unique and unparalleled as an engine of war. The Admiralty were called upon to prove their calculations and to demonstrate that the ship would swim under certain conditions of diminished buoyancy. This all necessitated a provident expenditure of time. Then, the progress which had been made in the manufacture of compound armour at Sheffield and the remarkable results which had been obtained from the experiments with the 100-ton gun at Spezia induced Mr. Barnaby to postpone the completion of the turrets until a number of steel and steel-faced armour plates had been tested on board the *Nettle* at Portsmouth. Here, again, the loss of time resulted in a substantial gain to the ship; for as the compound armour was found to be much superior to iron armour of even greater thickness and weight in resisting the blows and penetration of projectiles, it was eventually adopted for the protection of the *Inflexible's* turrets. There was also considerable delay in respect of the armament, the Woolwich authorities finding it difficult to arrive at a final understanding as to the calibre and chambering of the guns and the character and weight of the charges. Until the size of the cartridges had been communicated to the authorities at Portsmouth the magazines could not be proceeded with; while the delay in forwarding the guns prevented the turrets and turret fittings being advanced to completion. During the last six months, however, considerable progress has been made on board, and to the eyes of the uninitiated who beheld her as she steamed out of the harbour for the anchorage at Spithead, looking as bright and shipshape as new paint and scrubbing could make her, the *Inflexible* doubtless appeared as if she were ready for service at any moment. But this was far from being the case; for, although as regards the hull and machinery little remained to be done, the gunnery arrangements, owing in a great measure to the vacillation of the War Department and more particularly to the friction which characterizes the relations between the naval and the Woolwich authorities, were in a somewhat backward state, and the trials were ultimately precipitated without waiting for the completion of many of the fittings. Only three of the 80-ton guns had been placed on board, while the automatic sights of Sir William Armstrong & Co., the compound sights of Woolwich, the elevating arcs and gear, the dials for showing the training, the connexions for turning the fore turret from within, and the various indicating apparatus, remained to be fitted. The roof of the after turret had, indeed, been temporarily secured, but in the instance of the other turret, which contained the solitary gun, no roof had been provided. And when the makeshift conditions under which the gunnery trials were conducted and considered, it is evident that the ship in the best of circumstances would not have been got ready for the flag and pendant before midsummer. But now another difficulty has arisen. The ordnance authorities at Woolwich are still deliberating and cannot, apparently, make up their minds. The fourth gun, instead of being sent to Portsmouth, is to be despatched to Shoeburyness and fired for the purpose of preparing a range table. Before this, however, can be done it is necessary to determine the character of the powder, whether P2 or prismatic, and the weight of the cartridge, whether 425 lb. or 450 lb. for *maximum* charges. Hence the probability of numerous consultations and repeated experiments at Woolwich before the problems can be properly determined. Prismatic powder was exclusively used during the gunnery trials on board, and were the Admiralty and the dockyard officials authorized to settle the matter they would unhesitatingly decide in its favour. In the first place, its use would reduce the length of the cartridge from 60 in. to 52 in. while its hexagonal shape would allow of a natural form of air-spacing and thus dispense with zinc tubes and the use of quick-burning powder as priming. It would also enable each charge to be contained in its own case and brought direct to the gun, instead of having to be lifted in three or four parts, and placed in a common case at the loading position and in the vicinity of lights. And, in addition to these advantages, it would improve the working of the loading guides, which otherwise will require modification. Then there is another difficulty with regard to the electrical vents of the guns. We understand that Woolwich was provided with a design of a much-improved and highly efficient vent-piece, which would have effectually prevented the escape of gas. But the gunnery officials there insisted upon introducing modifications, and consequently discounted the merit of the invention to such an extent that there was a great escape of gas into the turrets on the explosion of the charges, and in one instance the vent-piece flew out of a gun and injured a man. The result of this bungling is that a strong impression prevails at Portsmouth that the whole of the guns may have to be lifted out of the ship and sent to Woolwich to be re-vented. Both the naval and the dockyard authorities, however, are becoming impatient at the loss of time which is taking place; and, while the former have suggested the desirability of commissioning the ship with three guns, the Shipwright Department have volunteered to undertake the matter of the venting, and thus redeem the service from the interference of Woolwich. But it is very unlikely that the ship will be commissioned with an imperfect armament since this would require the fore turret to be roofed and have its interior fittings completed, with the prospect of the entire work having to be done over again after the fourth gun is received.

We have already recorded the results of the gunnery trials, but it will be interesting to describe more at length the means by which they were obtained. But first as to the ship itself. Seen from a distance, the *Inflexible* appears deficient in the strangeness and ungainliness which have come to be associated with turret ships. This is in a great degree owing to the artistic manner in which the paint brush has been applied, and gives place to fresh impressions as a closer acquaintance affords greater distinctness of definition. The hull, superstructures, and turrets being all blackened, causes the whole floating mass to resemble an ordinary broadside ship of high freeboard; and if the reader will imagine the letter H to be place upon the hull of an ordinary man-of-war he will be furnished with a pretty accurate idea of the profile presented by the *Inflexible* at the distance of a few miles. The letter, which is rendered all the more conspicuous by reason of its being painted yellow, represents the two funnels and the flying deck which spans the intervening space. The distance between the funnels is 75 ft. 3 in.; and below the crossbar of the H are placed the turrets, which may be said to resemble colossal cheeses. Outside the uprights of the H and at distances respectively of 17 ft. and 21 ft. 9 in., the masts are fixed, which, unlike the derrick pole of an ordinary turret ship, are really fully equipped spars, and rise to a height in the case of the foremast to 109 ft. 9in., and in that of the mainmast to 172 ft. and 9 in. Though fitted with lower topsail, topgallant, and royal yards, and having a spread of upwards of 20,000 square yards of canvas, the masts are intended only for purposes of drill, but nevertheless serve to modify the appearance of grimness which would otherwise attach to the ship. With a near approach, the picturesque appearance of the structure disappears. The fore and aft superstructures recede from the sides and shrink into a narrow compass along the middle line, and thus allow of a sheer deck for the fire of the guns; the turrets become defined, the various trunks and cowls for relieving the under decks of their imprisoned hot air becomes visible, and the whole ship assumes the sternness of a floating war engine. This impression is strengthened the moment the visitor sets foot below, where the artificial light from the electric carbons only serves to show more plainly the tortuous character of the passages and the number and variety of the mechanical appliances. The flats at the fore and after ends below the armour deck have been literally transformed into engine rooms. Forward are placed the hydraulic engine and tank, the capstan engine, the engines for training the under-water tubes for discharging the Whitehead torpedoes, and which work one within the other by means of compressed air, the engines and reservoirs for charging the submerged and above-water torpedoes, the distilling condensers for supplying the crew with fresh water, the engine for distributing the water throughout the ship, and the engine for pumping overboard the water from the wash-places, while on the after-flat there are the second hydraulic engine and tank, the hydraulic hand pump, a steam-steering engine, the coupling for working the tiller by hand, and the tiller itself and gearing, a Brush electric machine for lighting up the fighting parts of the ship, with a Brotherhood engine for driving it, and a D Gramme machine for use as a protection against torpedo attacks by night, with another Brotherhood engine for turning it; and when to all this machinery are added the main engines and the numerous hydraulic machines for working the guns, it may be safely asserted that the *Inflexible* rather resembles a floating factory than a ship.

A very special interest attaches to the armament of the *Inflexible* not simply because it consists of four 80-ton guns—guns vastly more powerful than any yet mounted afloat in the English service—but because the guns are carried and worked on the remarkable hydraulic system which, at the time the ship was designed, had only been tried under somewhat makeshift conditions in the fore-turret of the *Thunderer*. The system has since been applied on board the *Dreadnought*, *Temeraire*, and *Neptune*, with various modifications and improvements, but in no instance with the completeness and thoroughness which mark the arrangements in the *Inflexible*. Some changes were rendered necessary by reason of the greater magnitude of the weights to be handled and the special exigencies to be provided against; but the special characteristic of the system is undoubtedly the fact that, owing to the development of the principle on board, steam, except as an accumulator of force, has been completely dispensed with the turrets as well as the gun gear being, for the first time in the history of the navy, worked entirely by hydraulic power. It may also be pointed out that the *Inflexible* differs from all other turret ships hitherto constructed in the circumstance that the turrets are not built on the centre line of the ship, but are set *en echelon*, or diagonally, in opposite corners of the great central battery or citadel. By this arrangement—which is so obviously superior to the one embodied in the *Thunderer* and *Hecate* classes that it has been adopted in the designs of the *Colossus* and the other turret ships now in course of construction—all the guns can be fired together directly forward or aft without either turret obstructing the fire of the other. Besides these advantages, which are supreme, the two guns of each turret can be projected clear of the ship's side for broadside fire, in the case of the one turret to port and in the case of the other to starboard, in which position they can be depressed to an angle of 6½ degrees. This would not only enable them to strike a vessel at close quarters below the line of her armour, but even to fire down on her deck should the enemy be ranged alongside. The internal diameter of the turrets is 28 ft., and as the total length of the guns is 26 ft. 9 in., it is impossible to run them in completely under shelter. When in the loading position the muzzle is protruded about 3 ft., while for firing the guns are run out to the distance of 9 ft. The turrets are protected by armour plates of 16 in. thickness, with suitable backing, except in the wake of the ports, where the protection reaches a thickness of 17 in. The outer strake of plating is composed of Messrs. Cammell's compound armour, having a steel face 3¾ in. in thickness, welded upon iron plating 5¼ in. thick; while the inner belt consists of 7-inch iron armour, increasing to 8 in. near the ports. The iron walls of the battery, on the other hand, in which the turrets are placed are of a total thickness of 24 in. The reduction of the thickness of the turret armour as compared with the protection of the citadel is due to the following considerations:—In the first place, the new system of manufacturing steel-faced armour, which has been perfected since the battery armour was fixed in position, permitted of a considerable decrease of thickness without impairing the efficiency of the plating in breaking up projectiles, the practical result being a great saving in weight, which the enormous increase in the size of the gun rendered necessary. In the next place, the increase of the bulk of the guns themselves, and the fact of their having assumed the simple form of muzzle-loaders, rendered them in a high degree self-protective. Then there was the added condition, that the plan adopted for mounting and working the guns was one which dispensed with the usual carriage and the ordinary paraphernalia of chains, cog-wheels, and delicate gearing; and not only with them, but also with the attendance of a numerous crew within the turret. Thus even the successful entrance of an enemy's projectile (which must, at any rate, be almost spent by passage through the 16 ins. of iron and steel) might be esteemed no very serious risk, such as that which would attend the penetration of the battery. And since the same considerations will take effect in an increased degree with every increase in the size of turret guns, it is far from unlikely that, should the enormous armament of the *Inflexible* prove less than all powerful, we may see still heavier guns introduced in the turrets of similar ships, at a mere sacrifice of an inch or two in the thickness of their armour. The present weight of each turret of the *Inflexible*, including the pair of guns, is not less than 700 tons.

(*To be continued.*)

LAUNCHES AND TRIAL TRIPS.

We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Marie.—On December 28th, a screw steamer, named *Marie*, was launched at Palmer's yard, Jarrow, for Messrs. Burdick & Cook, of London. The *Marie* is 250 ft. long, 33 ft. in breadth, and 18 ft. 6 in. in depth of hold, the gross registered tonnage being 1,400 tons. The vessel is built under special survey, and will be classed 100 A 1; the highest class at Lloyd's. She will be fitted with engines of 120 horse-power nominal. The vessel is built for Messrs. Burdick & Cook, London, and is intended for the Baltic and Black Sea trade, for which she is specially designed and constructed. The ceremony of naming the ship the *Marie* was performed by Mrs. Cook, wife of one of the Managing Owners.

Alleghany.—On the 30th December, Messrs. M. Pearse & Co. launched from their iron shipbuilding establishment at Stockton an iron screw steamer of the following dimensions:—Length, 300 ft; breadth, 36 ft; depth, 25 ft. 6 in; gross register tonnage, about 2,250 tons; dead weight, cargo, and fuel capacity, about 3,300 tons. The steamer will be classed in the highest class (100 A 1) at Lloyd's, under special survey; she is built off the three-decked rule, with double bottom for water ballast, short full poop, bridge-house, topgallant forecastle, and is fitted with four steam winches, port windlass, steam steering gear, &c. Engines are of 280 horse-power, by Messrs. Blair & Co., on the compound direct-acting surface-condensing principle. As the vessel took the water she received the name of *Alleghany*, and will beregistered at Liverpool.

Nemesis.—On December the 30th, Messrs. Turnbull & Sons launched from their shipbuilding-yard at Whitby a new iron screw steamer of the following dimensions, viz:—Length, 240 ft; breadth, 34 ft; depth of hold, 17 ft. 9 in. with a dead-weight carrying capacity of about 1,950 tons. The vessel is built to Lloyd's highest class (100 A 1), under special survey of hull and engines, for Mr. T. Parker, of Melbourne, Australia, and is intended for the Australian coasting trade. As she left the ways she was christened the *Nemesis* by Mrs. Parker, wife of the Owner. Her engines are of 120 horse-power, by Blair & Co., Stockton-on-Tees.

Cranbrook.—On the 30th December, a screw steamer was launched from the Tyne Iron Shipbuilding Company, at Wallsend, named the *Cranbrook*. Her dimensions are—280 ft. by 36 ft. by 24; class 100 A 1 at Lloyd's; her engines, 33 in. by 63 in. by 39; boilers, 80 lbs. pressure; dead weight, including bunkers, 2,850 tons.

St. Dunstan.—On January 1 there was launched from the building yard of Messrs. Andrew Leslie & Co., Hebburn-on-Tyne, the screw steamer *St. Dunstan*, 2,250 tons gross, 1,470 tons nett register, 250 horse-power, compound engines by Messrs. Hawthorne & Co., class 100 A 1 at Lloyd's, and the highest in the Liverpool book. She will carry 3,100 tons, and steam 10½ knots. She is built for Messrs. Rankin, Gilmour & Co., of Liverpool and London, for their Atlantic service, and was named by Miss Annie Rankin Strang, daughter of one of the partners.

Ingoldsby.—On the 13th January a screw steamer was launched from the yard of Palmer's Company, Jarrow. The vessel has been built to the order of Messrs. Lee, Finch & Co., Cardiff, the dimensions being:—Length over all, 245 ft.; beam, 32 ft.; depth of hold, 18 ft. She will carry 1,800 tons deadweight, and be propelled by a pair of Palmer's engines of 120 horse-power; patent windlass by Emerson, Walker & Co. She is classed 100 A 1 at Lloyds, and is intended for the Mediterranean and general trades. Before leaving the ways the vessel was christened the *Ingoldsby* by Mrs. Pawley, wife of Captain Pawley, who will command the steamer, and daughter of Mr. R. Lee, one of the managing directors.

Ida.—On the 13th January a ketch barge was launched from the shipbuilding yard of Messrs. Bailey & Sons, Ipswich, of the following dimensions, viz.:—Length aloft, 99 ft. 10 in.; breadth, 23 ft. 3½ in.; depth of side, 10 ft. Built under special survey, to class 10 years A 1 at Lloyd's. She was named *Ida*, and is intended for the coasting trade. Messrs. R. & W. Paul, corn merchants, of Ipswich, are the owners, and Captain Gibbs has been appointed master.

Ravensdale.—On January 15 Messrs. Edward Withy & Co. launched from Middleton Shipyard, West Hartlepool, an iron screw steamer, built to the order of Mr. George Steel for Messrs. Steel, Young & Co., London and West Hartlepool. Her principal dimensions are:—Length, B.P., 225 ft.; beam (extreme), 30 ft.; depth (moulded), 17 ft. 11 in She is built to Lloyd's highest class, and has topgallant forecastle, bridge-house, and long quarter deck; double bottom, all fore-and-aft, on the cellular principle; iron decks, chart-house, engine skylight, and cabin deck-house. She will be fitted with engines of 110 nominal horse-power by Messrs. T. Richardson & Sons, of Hartlepool Iron Works. This vessel is No. 93 in the builders' books, and is the 17th built for the same owners. As the steamer left the ways she was christened *Ravensdale* by Miss Clara Seal.

Aristomene.—On the 17th January Messrs. W. H. Potter & Son launched from their Shipbuilding Works, Liverpool, an iron sailing ship of the following dimensions:—Length, 280 ft.; beam, 39 ft.; depth in hold, 24 ft.; tonnage, builder's measurement, 2,000 tons, and 1,800 tons register. The vessel was christened the *Aristomene* by Mrs. C. W. Corsar. The *Aristomene* has been built to the order of Messrs. Henry Fernie & Sons, and is a duplicate of the *Laomene*, launched from the same works last year, being the first of three vessels that W. H. Potter & Son have in hand for the same owners. She is classed 100 A at Lloyd's, and 20 years in red in the Liverpool Underwriters' Book. After receiving her masts and other fittings, the *Aristomene* will be placed on the berth for Melbourne. She will be commanded by Captain J. W. Attbridge, late of the ship *Knight Commander*.

Irby.—On the 17th Jauuary Messrs. R. & J. Evans & Co. launched from their shipbuilding yard at the Brunswick Dock, Liverpool, an iron clipper ship, built to the order of Messrs. Ismay, Imrie & Co., of the White Star Line of steam and sailing vessels. On leaving the ways she was named the *Irby* by Mrs. Leslie, wife of Captain Leslie, their Marine Superintendent, and will immediately take her station on the berth for San Francisco. Her dimensions are:—Length, 237 ft. 6 in.; breadth, 38 ft. 9 in.; and depth 23 ft. 3 in.; tonnage, 1,487 tons nett register. She has been built to class *100 A 1, and meets the highest requirements at Lloyd's.

Germaine.—On Monday the 17th inst., Messrs. Forrestt & Son launched from the Britannia Yard at Limehouse a finely modelled iron screw steamer of the following dimensions:—Length between perpendiculars, 88 ft.; length over all, 93 ft.; breadth, 14 ft.; depth, 7 ft. The vessel has been built to the order of Captain A. M. Gallet, of 16, Mark-lane, City, for Messrs. Buhan Sons & Tissicre, of Bordeaux, and is intended for cargo and towing service on the West Coast of Africa. Her engines are of the compound surface condensing principle, the cylinders being 12½ and 22 in. diameter, the stroke 16 in. Both engines and boiler have been made by Messrs. Smurthwaite & Armstrong, of Limehouse. The launch was one of some difficulty, owing to the shallowness of the water, and the great height at which the vessel had to be constructed. However, at the appointed time, 3.15 p.m., the word was given to "down dogshore," and the vessel having been duly christened, the *Germaine*, by Captain Gallet, on behalf of the owner's daughter, glided rapidly down the ways, not noiselessly though, for the water being coated with ice about one and a half inches thick, there was a terrible crashing as the vessel took to her native element. In addition to the large number of wood boats, launches, yachts, &c., of all descriptions which Messrs. Forrestt & Son are at present building, they are now completing a very fine 130 ton composite yacht with steel framing, and a steel stern wheel steamer for South America. They are also laying down two steel launches, and an iron launch, all for foreign ports. We may mention that Messrs. Forrestt & Son were the builders of the steel boats for the Belgian Government which are being used in the African Exploration Expedition, under the command of Col. Strauch, and are at the present time building a large sailing vessel to the order of the Rev. Grattan Guinness, for the exploration of the River Congo.

Barbados.—At West Hartlepool Messrs. Gray & Co. launched from their yard, on the 30th December, a fine first-class passenger steamer, built to the order of the Quebec Steamship Company, of Quebec and New York, and intended for their New York, Bermuda, and West India lines. Dimensions: length 280 ft., breadth 34 ft. 6in., depth 24 ft. 6in. to top of spar deck; with midships' houses over half the length of the vessel affording accommodation for officers' servants, kitchen, pantries, bakehouse, lamp-room, stores, companion hall to saloons, ladies' sitting-room, smoking-room, eight state rooms for first-class passengers, &c. Three decks are laid. The maintween decks contain an elegantly-fitted dining saloon 30 ft. long and 34 ft. 6 in. wide; whole width of ship capable of seating 70 passengers; furnished with sofas, revolving chairs, &c. Another large saloon aft of dining saloon is fitted and furnished in a similar manner, and has first-class staterooms on each side and aft, also forward of dining-room; 27 staterooms in all on main-between-decks, with eight on spa deck fitted for three passengers each, affording accommodation for 105 first-class passengers. The second-class cabins on main deck, forward of engines, contain accommodation for 24 passengers, with dining-room in centre, all fitted in a neat commodious manner. Forward of the second cabin, but separated by a water-tight bulwark, is a space for 60 head of cattle, ice house for 30 tons, steerage for 20 passengers, and forecastle for crew 16. The saloons and lobbies, halls, ladies' room, &c., are finished in fine polished hardwood, solid, ornamented with gold, fittings in silver; staterooms are entered from passages leading from lobbies. Staterooms and lobbies are all lighted by large circular side lights; light and ventilation is also obtained from large skylights on deck and from light in side of deck houses. As the steamer is intended to trade in a very warm climate, special attention has been given to ventilation. The pantries are large and fitted with hot chests, and every convenience for a first-class passenger steamer. The staterooms are fitted up elegantly with all modern conveniences. Five bathrooms are fitted with hot and cold water, and the whole of the saloons and cabins are heated with steam. The vessel is furnished with steam stearing gear and steam windlass; steam winches at each hatch; has water ballast forward midship and aft, so that she can be trimmed as desired. The engines are by Messrs. Blair & Co., and are 200-horse power nominal, and as the vessel has very fine lines it is expected a high rate of speed will be obtained. The vessel has been built under the special survey of Lloyd's for the 100 A 1 Class and Board of Trade Foreign-going Passenger Certificate, and has been superintended by the general manager of the company, and no expense has been spared to fit her in every way as a first-class passenger steamer. As she left the ways, she was named the *Barbados* by Mrs. Moore, wife of the manager of the company. This name will be changed to the "*Orinoco*."

LAUNCHES.—SCOTCH.

Lee.—On the 30th December, an iron screw-steamer, named *Lee*, of 2,000 tons, built and engined by Messrs. W. Simons & Co., was launched complete from their works at Renfrew. It is the property of the City of Cork Steam Packet Company, and is intended for the Channel trade. The steamer is fitted with compound engines of 1,000-horse power and steel boilers, and is constructed with a double bottom fore and aft for water ballast, and has accommodation amidships for 80 first class passengers. It is built for the highest class at Lloyd's and the Board of Trade, and has steam appliances for loading, mooring, steering, and discharging.

Kangra.—On December 30th, Messrs. William Denny & Brothers launched from their shipyard at Dumbarton the *Kangra*, an iron screw steamship of the following dimensions—285 feet by 35 feet by 26 feet 6 inches, and about 2,000 tons gross measurement, for the British India Steam Navigation Company (Limited). She has been built to class 100 A 1 at Lloyd's under special survey, and is to be fitted with compound surface direct-acting inverted cylinder engines of 200-h.p. nominal, by Messrs. Denny & Co. She is constructed on the continuous double-bottom system, so largely employed by her builders, and with deep plate frames on the sides. A peculiarity of the double-bottom in this steamer is that it is not only structural and continuous, but that it extends from the fore-peak bulkhead to the after-peak bulkhead. The *Kangra*, on leaving the ways, was named by Miss Jennie Tullach, daughter of the late John Tulloch, of Bellfield, Dumbarton, formerly managing partner of the firm of Denny & Co.

Acorn.—On January 1st last there was launched from Messrs. Campbell & Co.'s yard, Paisley, an iron screw steamer of 165 feet in length, 24 feet 6 inches in breadth, and 13 feet depth of hold, and about 500 tons gross register, for Messrs P. H. Dixon & Co., 71, Waterloo-street, Glasgow. The vessel, which has been built under special survey for Lloyd's 100 A 1 class, was christened *Acorn* as she left the ways, and is to be fitted with a pair of compound engines of 75-horse power by Messrs. Muir & Houston, Kinning-park, Glasgow. She is intended for the general trade, and is fitted with water ballast, large hatches, steam winches, and all appliances to ensure economy in working, and expedition in loading and discharging cargoes.

Benabourd.—On the 5th January there was launched from the building yard of Messrs. Hall, Russel, & Co., at Aberdeen, an iron screw-steamer named the *Benabourd*, of the following dimensions—Length 195 feet, breadth 31 feet 6 inches, depth 13 feet 6 inches, and 790 tons gross register. This vessel has been built under special survey to class 100 A 1 at Lloyd's, and will be fitted with compound surface-condensing engines 85-horse power nominal, water ballast, steam winches, patent windlass, and all the most new and approved appliances, for facilitating the loading and discharging cargoes. The *Benabourd* has been built to the order of Messrs. J. & A. Davidson, Aberdeen, and is the twelfth vessel built by Messrs. Hall, Russel & Co. for the same owners. As the vessel was leaving the ways she was named *Benabourd* by Mrs. Scott. The vessel was afterwards taken to the sheer poles for the purpose of receiving masts and machinery.

Strathyre.—On January 14th, Messrs. Henry Murray & Co., launched from their shipbuilding-yard, Port Glasgow, a screw-steamer of the following dimensions:—144 ft. by 23 ft. 6 in. by 11 ft. 6 in. and classed 100 A1 at Lloyd's. She is built to the order of Messrs. James Hay & Sons, Glasgow. Mr. William Kemp, of Govan, supplies her with compound surface-condensing engines of 70 horse-power. As she left the ways, she was named the *Strathyre*, by Miss Small, of Glasgow.

Alligator.—On the 12th Jaunary, a steamer intended for Messrs. Burns' Royal Mail Service between Glasgow, Greenock, and Belfast, was launched from the building yard of Messrs. Barclay, Curle, & Co., at Whiteinch. The ceremony of naming her the *Alligator* was performed by Miss Muir, daughter of Messrs. Burns' superintending engineer. Her dimensions are:—Length, 260 ft; breadth, 30 ft.; depth, 15¾ ft.; and she will be fitted by her builders with engines of great power, which, combined with the beauty of her lines and model, will ensure for her an exceptionally high rate of speed. Besides possessing extensive cargo capacity and a capacious steerage, as well as a cattle dealers' sleeping cabin, she has a very large poop saloon, which is to be fitted with accommodation for upwards of 100 first-class passengers. The *Alligator* is the first of three sister steamers, now in course of construction by Messrs. Barclay, Curle & Co., for Messrs. Burns. These vessels have been specially designed to meet the requirements of the Scotch and Irish mail service, and along with other two steamers, now building for Messrs. Burns by Messrs. Blackwood & Gordon, at Port Glasgow, will be completed and ready for sea in a few months, when they will all be placed on the station between Glasgow, Greenock, and North of Ireland ports.

Lylie.—On January 12th, Messrs. H. M'Intyre & Co., launched from their shipbuilding-yard at Merksworth, Paisley, the *Lylie* an iron screw-steamer of 850 tons, built to the order of George Bargate & Co., Barrow. The *Lylie*, which is built to the highest at Lloyd's under special survey, and fitted with all the most modern improvements, will be engined by Messrs. Hutson & Corbett, Glasgow. The ceremony of naming was performed by Miss J. W. Woodburn, Ayr.

Thetis.—An addition to the Dundee whaling fleet was made on January 13th, by the launch of the screw steamer *Thetis*, which has been built by Messrs. Alexander Stephen & Sons, the owners of the vessel. A large assemblage witnessed the launch, and the ship was christened by Mrs. A. G. Thomson. The *Thetis* is a beautifully modelled craft of 805 tons, builders' measurement, her dimensions being—Length, 181 ft. breadth, 30½ ft.; and depth of hold, 19 ft. She has been built in the strongest possible manner to fit her for Arctic navigation, the frame being composed of German oak, the planking of elm and pitch pine, and the doubling of iron bark, while the bows are fortified with diagonal timbers. She will be fitted by Mr. W. B. Thompson, with compound engines of 100 horse-power. Captain Brown, formerly of the *Perserverance*, of Peterhead, is to command the *Thetis*, which will be engaged in the spring at the Newfoundland seal fishing under the command of Captain Daw. Thereafter she is to be employed under Captain Brown at the old seal fishing between Cape Farewell and Iceland, where good cargoes have been obtained in recent years by the Norwegian sealers.

Nithsdale.—On January 15th, there was launched from the shipbuilding-yard of Messrs. Cunliffe & Dunlop, Port Glasgow, the *Nithsdale*, an iron screw-steamer, of the following dimensions:—Length, 240 ft.; breadth of beam, 32 ft. 6 in.; depth of hold, 17 ft.; built to the highest class at Lloyd's under special survey; gross register about 1,200 tons, and fitted with all the most modern improvements, including water ballast on cellular principle. The engines, which are supplied by the builders, are on the compound surface-condensing principle, of 130 horse-power. This vessel has been built to the order of Messrs. Robert Mackill & Co., Steamship Brokers, Glasgow, and is intended to be employed by them in the Mediterranean and general trades. The ceremony of naming the vessel was performed by Miss Bost, Glasgow.

Saigon.—On January 15 there was launched from the shipbuilding-yard of Messrs. Ramage & Ferguson, Leith, a screw steamer of about 1,200 tons burthen and 100-horse power nominal, for the Eastern trade. She is fitted with all the latest improvements, including Emerson Walker & Co.'s patent combination windlass. On leaving the ways she was named the *Saigon* by Miss Galloway, of Summerside, and afterwards was towed round to the harbour to receive her machinery.

Fylde.—On the 17th January there was launched from the shipbuilding-yard of Messrs. John Reid & Co., Port Glasgow, an iron twin screw tug steamer, named the *Fylde*, of the following dimensions:—122 by 22 by 11, 220 tons. This vessel has been built to order of the London and North-Western and Lancashire and Yorkshire Railways for harbour purposes. Her engines, 120 nominal horse power, will be furnished by Messrs. Rankin & Blackmore.

Khokand.—On the 17th January Messrs. Russell & Co. launched from their Greenock yard an iron sailing vessel of about 1,100 tons register, built above Lloyd's requirements for the highest class, and of very large deadweight capacity. The vessel is owned by Messrs. W. & J. Crawford, and as she left the ways was named the *Khokand* by Mrs. Hair, 33, Union-street, Greenock. The ship has been chartered by Messrs. Thomas Skinner & Co. to load a general cargo in Port Glasgow for San Francisco, and will be commanded by Captain David Wright.

Cushie-Doo.—On the 21st January Messrs. David & William Henderson & Co. launched from their Meadowside Works, Partick, a screw steam yacht for W. H. Osmond, Esq., of Melbourne. The vessel has been built to meet Lloyd's requirements for the highest class, and her dimensions are:—Length, 145 feet; breadth, 24 feet; depth, 12 feet 9 inches; tonnage, 350 tons. On leaving the ways the vessel was named *Cushie-Doo* by Mrs. Charles V. Merriman, St. Clement's Rectory, Salford, Manchester. The vessel has been supplied by the builders with machinery of the most improved description, and will leave shortly for Melbourne, via Suez Canal, under the command of Captain William Gilchrist.

LAUNCH.—IRISH.

Black Head.—On January 15 an iron screw steamer named the *Black Head* was launched from the shipbuilding-yard of Messrs. Harland & Wolff, Queen's Island, Belfast. The steamer is for local owners, having been built to the order of the Ulster Steamship Company (Limited), of which Messrs. G. Heyn & Sons, Ulster-chambers, Belfast, are the managers, and will be engaged in the Baltic and Mediterranean trades, principally in connection with Belfast. The dimensions of the *Black Head* are:—Length, 250 feet; breadth, 31 feet 3 inches; depth, 17 feet 6 inches; about 1,250 tons gross and 750 tons nett register. The vessel is expected to carry about 1,800 tons dead weight. The engines, which are to be supplied by Messrs. James Howden & Co., of Glasgow, are on the compound surface condensing principle, with all the latest improvements. They will be about 140 nominal horse-power, the cylinders being 28 inches and 53 inches, with 3 feet 2 inches length of stroke. Steam will be supplied from two boilers with large heating surface, and of superior construction, by same makers. The hull is built upon the longitudinal bracket system, having a double bottom extending fore and aft, fitted for water ballast, with extra strengthening, and bracketed upon every frame; long half-poop and bridge-house, with accommodation for officers and engineers amidships, and topgallant forecastle fitted for crew. The steamer, which is classed 100 A 1 at Lloyd's, will be schooner-rigged, with two iron polemasts; she has four large hatchways; will be fitted with patent steam-steering gear by Messrs. Muir & Caldwell, Glasgow, and special hand-steering gear in an iron house aft, patent windlass, four powerful steam winches, and other facilities for very rapid loading and discharging of cargoes. The *Black Head* will be towed to Glasgow to have machinery placed on board, and will then return to Belfast for remainder of outfit. She will be commanded by Captain Thomas M'Calmont, now in charge of the *White Head* (s), belonging to the same owners.

TRIAL TRIPS.

Persian Monarch.—The trial trip of the new steamship *Persian Monarch*, 4,000 tons, 360ft. between the perpendiculars, 43ft. 1in. beam, 28ft. 3in. depth, took place on Friday at Greenock, with results as gratifying to the owners, the Royal Exchange Shipping Company (Limited), Messrs. Patton & Co., as it is creditable to the eminent constructors, Messrs. Macmillan & Sons, of Dumbarton, and Messrs. D. Rowan & Co., of Glasgow, the engineers whose united efforts have brought this noble structure to so successful a termination. The vessel is from the yard of the former firm, who have the honour of being the builders of the largest sailing ship that has ever yet left the Clyde. She is constructed to carry 4,000 tons dead weight cargo, and 500 tons of coal, on a draught of 23ft., with a freeboard of about 13½ft. There are four decks. The 'tween and the main are of iron, the former sheathed with pitch pine, the latter of yellow pine, the upper deck of teak. The engines are of the direct acting compound class, constructed to move a load displacement of 7,000 tons. The high-pressure slide-valves have expansion valves so arranged that the grade of expansion may be readily altered while the engines are in motion. The three large boilers are tubular, and fired at both ends. There are twelve of Fox's corrugated furnaces, four in each boiler. The working pressure is 80lb. to the square inch. The fittings and appointments, while solid and useful, are of the ordinary character, suited to the conveyance of cattle, sheep, grain, and provisions from America to this country. The trial trip took place, under extremely favourable circumstances, in Wemyss Bay, and the measured mile was run five times, showing a mean of 12½ knots, the displacement being about 5,400 tons. The obedience of the structure to her steering gear was perfect, evidenced by the rapidity with which she described the half-circle. The engines, which have had the careful superintendence of Mr. Esplen, of Liverpool, left nothing to be desired. The general outfit of the ship has been faithfully watched by Captain Wawn. The day was fine, with brilliant sunshine. Those on board were mainly professional men, among whom were—Messrs. W. Ramsden Price, W. R. Hartridge, D. W. Allport, Royal Mail Steam Packet Company, all of London F. G. Fry, W. Esplen, Liverpool; D. Rowan, Jas. Rowan, engineers; Captain Wawn, Captain, Mrs., and Miss Duncombe; and Robt. C. Hamilton. The Board of Trade, Lloyd's, and the Bureau Veritas were represented. All expressed the utmost satisfaction with the results witnessed.

Rhenania.—This vessel, of 1,900 tons, built to highest class for the Hamburg-American Company by Messrs. Dobie & Co., Govan, and engined by Messrs. James Howden & Co., Scotland-street, had the official trial of her machinery, &c., performed on the Clyde, when speed and consumption of fuel were both tested with the most satisfactory results to all concerned. The *Rhenania* has since proceeded to Hamburg to take up her station for the Atlantic traffic.

Cotherstone—The s.s. *Cotherstone* which has been built by Messrs. Short Bros., and engined by Mr. John Dickinson, of Sunderland, for Mr. J. S. Barwick, went on her trial trip on New Year's Day under the superintendence of Mr. Joseph R. Oldham. The vessel has a double bottom with water ballast all fore and aft, and is of the "spar" deck type. She has two complete iron decks, the upper one and the top sides generally being much heavier than required, by rule the cylinders are 36 in. and 68 in. by 44 in., and there are two large boilers with six furnaces, and she is fitted with an extra powerful "Blake" donkey boiler, the working pressure being 80 lbs.

Romeo (s.).—The trial trip of the *Romeo* (s.) took place on the 6th January. She was built by Messrs. Murdoch & Murray, of Port-Glasgow, and engined by Messrs. Muir & Houston, Harbour Engine Works, Glasgow, and owned by the Marquis de Campo, of Madrid. This vessel is intended for the Manila coasting trade. Her dimensions are as follows:—155 by 22 by 12, and 100 A 1 at Lloyd's. The steamer is fitted with an elegant saloon for passengers, special care being taken to supply good ventilation, and the speed obtained was 10 knots on a small consumption of fuel, with 250 tons on board, which was considered highly satisfactory by the representatives of the owners.

Pembroke.—The Great Western Railway Company's new paddle steamer *Pembroke*, built by Messrs. Laird Brothers, the launch of which we noticed a few weeks since, having had her machinery fitted on board, and been otherwise completed for sea, made her official trial trip on January 11th, preparatory to being handed over to the company, and taking her place in their Milford and Waterford service. Like several of the latest and most successful Channel steamers, the *Pembroke* has been constructed entirely of Siemen's steel, made at the Landore Works. She is 253 feet in length, 30 feet 9 inches in breadth, 15 feet deep in hold, and measures 1,182 tons O.M., and is fitted with a pair of Messrs. Laird's double piston-rod vertical oscillating compound engines of the most improved type, having two cylinders 53 in. and 91 in. diameter, with 7-feet stroke, supplied with steam at 75 lb. pressure from two cylindrical boilers, each having six furnaces. The passenger accommodation is provided in a full poop, entirely shut off from those parts of the vessel where the cattle are stowed. Fittings are provided for about 350 head of cattle, special attention having been devoted to the ventilation of the holds and 'tween decks, and the arrangements for the embarkation of the animals.

Several runs were made with and against the tide between the Bar and the North-West Lightships, the results giving a mean speed of 16·1 knots an hour, the engines making 31 revolutions with 73 lbs. pressure of steam, and developing about 2,400 i.h.p. These results were considered satisfactory.

Stuart (s.s.)—On the 11th inst. the *Stuart* s.s. which has been built by Messrs. William Pickersgill & Sons, of Santhwich, Sunderland, for Mr. John Bacon, of Liverpool, went on her trial trip loaded. The engines 120 NP are by Mr. George Clark, of Sunderland. Cylinders, 29½ in. and 55 in. by 36 in. stroke, two single ended boilers with four furnaces; working pressure 80. The indicated horse power, with easy steaming, was 550. Average speed of vessel against the wind and tide, 8⅝ knots with 1850 tons of coal on board. The vessel and machinery which has been built under the superintendence of Mr. Joseph R. Oldham gave every satisfaction. There is another sister steamer on the same stocks for the same owner, which will also be engined by the celebrated Santhwich Engineering Firm. The vessel takes the highest class in Lloyd's Registers, and is considerably in excess of their rules.

Manila.—On the 19th of January the steamship *Manila* (formerly the Cunard liner *Siberia*), having been sold to a Spanish firm, recently underwent an extensive overhaul, in Hull, with new boilers and machinery, at the hands of her original builders, Messrs. J. and G. Thomson, Clydebank, She left the builder's premises for the Gareloch, to adjust compasses, in command of Captain James Stewart, Pilot, and afterwards ran the usual trip at the measured mile off Skelmorlie, making six runs at a speed of 13½ knots per hour, which was considered highly satisfactory. She returned to Glasgow in the evening, and subsequently left for Liverpool to load for Manila, via the Suez Canal.

Accretive.—This new steamer steamed out of the South Dock, after taking in cargo, on January 22nd, to adjust compasses and make her trial trip. After the adjustment was finished, the managing owners, Messrs. Coatsworth, Stockdale, & Co., represented by Captain Stockdale, and a party of friends came on board in a tug, and the vessel proceeded at full speed. Notwithstanding that the sea was very heavy, the spray at times coming over the bows, the vessel and engines performed admirably and to the entire satisfaction of all concerned. The ship steamed well and rolled very easily, and the engines, although not connected to the governor, worked very steadily and without any vibration. The *Accretive* is 225·4 by 33 by 16·5; 1,202 tons gross and 778 tons net, highest class at Liverpool registry, with long half poop, bridge-house, and topgallant forecastle, double bottom in main and after holds, iron decks, self-trimming hatchways, Emerson and Walker's windlass, chart-house, bridge, and after stearing-gear, is schooner-rigged, and equipped fully for the coal iron ore, and general trades. She was built by Messrs. S. P. Austin & Son, engined by Mr. G. Clark, Southwick, nominal h.p. 99, effective 490, cylinders 28 and 53 by 36 inch stroke, fitted with two boilers, pulsometer ballast pump, and all the latest improvements. The *Accretive* steamed away at 2 p.m. for Malta.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters likely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

IMPORTANT NOTICE.

The Editor would be happy to receive from Shipowners, Marine Engineers, and others, accounts as to the best means to prevent pitting in boilers, priming, etc., management of engines at sea, their experiences of breakdowns, repairs, etc., etc., and would willingly find room for them and give the illustrations when drawings can be sent.

To the Editor of the MARINE ENGINEER.

SIR,—No one who has read the article on "Speed Causes" on page 128 of your January number, can have failed to notice the marvellous difference in th eefficiency of the two ships, *Charles-Quint* and *Shamrock*. Roughly, these are the particulars :—

	Displacement.	Augmented Surface.	T.H.P.	Speed
Charles-Quint ...	2478 ...	15266 ...	2060 ...	15·11
Shamrock ...	1295 ...	10073 ...	2050 ...	14·5

So that the *CharlesQuint*, which is more than half as big again as the *Shamrock* is driven with practically the same power more than half a knot faster! What I wish to ask is, do or can Messrs. Inglis give any reason for, or explanation of, the very bad results obtained in the case of the *Shamrock?* The *Shamrock*, compared with the results got from the *Charles-Quint*, ought to have attained a speed of 16½ knots.

W. K.

Notes and Novelties.

A NEW cruiser for the Chinese squadron at Hong Kong, called the *Loo-chi*, has been launched at Kowloon Docks. She is 108 feet long and 18 feet beam, and will be fitted by the company with machinery which will enable her to travel at the rate of 13 miles per hour.

SHIPBUILDING ON THE WEAR IN 1880.—Shipbuilding on the Wear during the last 12 months has been characterized by great prosperity, and has in this respect been in marked contrast with the state of the industry in the preceding year. The year closed with the trade in a state of very great activity, all the yards being full of orders, fresh contracts only being received at enhanced rates. The total number of vessels completed during the year was 77, of a nett registered tonnage of 116,227. In 1879 the number was only 64, with a tonnage of 92,176. Of the total 77 only one was of wood, of 329 tons burthen. Besides this vessel there were only two other sailing ships built, each being of 1,436 tons burthen. Most of the vessels were classed in the highest registries, and are of great carrying capacity. The largest was the *Brindisi*, a Peninsula and Oriental Mail steamer, of 3,542 tons nett. The orders in hand, which in many cases will last all this year, are mostly for vessels of high tonnage, and the day of small steamers seems to be rapidly passing away.

NEW STEAMER FOR THE AMERICAN TRADE.—The North German Lloyd have ordered a new steamer of the firm of Messrs. John Elder & Co., of Govan, to surpass the other steamers of their fleet in size, speed, and general appointments. She is to be named the *Elbe*, and is to be delivered to the company next June. The *Elbe* will be of 5,000 tons measurement, and her dimensions will be 420 ft. in length by 45 ft. breadth of beam and 40 ft. depth of hold. She will be provided with seven watertight compartments, and will have four masts, the fore and main masts square-rigged, and the two mizzen-masts schooner-rigged. Her engines will be of 6,000-horse power indicated, and will consist of three cylinders, the high-pressure of 60 inches diameter, and the two low pressure of 85 inches diameter each, and guaranteed to obtain a speed of 16 miles an hour. All the saloon and state rooms accommodation for first class passengers will be placed amidships, forward of the engines, and that for the second class in the after part of the vessel.

SOCIAL GATHERING OF SCOTCH ENGINEERS.—A grand social gathering of Scotch foremen and marine engineers, representing the principal firms at the East-end of London, and the various Mail Companies, took place on the evening of December 30th, at the "Old Commodore," High street, Poplar. The chair was taken by Mr. Ferrie, the vice-chair being occupied by Mr. Macfarlane, between forty and fifty gentlemen sitting down to an excellent supper provided by Mr. Lukes, the genial landlord of the hostelry. The various loyal and patriotic toasts were heartily responded to, but that of "Absent friends" was received with especial favour. During the evening a first-class selection of Scottish and humorous vocal and instrumental music was given by various gentlemen, specially noticeable, perhaps, being the overture on the piano by Mr. Macfarlane. The dramatic selections given by Mr. Ferguson, of the Orient line, who is generally known amongst our friends from the North as the "eminent Scotch delineator," were "grandly" done, and roused to its fullest extent the patriotism of his hearers. Altogether, the gathering—thanks to the efforts of the committee, Messrs. Paterson, Russell, and Macfarlane (who were ably seconded by their host, Mr. Lukes)—was a great success, and, as Sandy would say, it was growing "dark i' the morn" when the company stood up, joined and crossed hands, and the strains of "Auld Lang Syne" told that the time for parting was near at hand.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 21st December, 1880, to 20th January, 1881.

5348 J. H. Johnson (communicated by G. W. Wood). Elevating and discharging coal, &c.
5358 T. F. Lyte. Protection of vessels and structures of iron and steel from corrosion and fouling.
5362 J. D. Churchill. Regulating steam supply.
5363 A. E. Newton (communicated by J. Ericsson). Guns, vessels, and explosive projectiles for submarine warfare.
5370 J. Brown. Disengaging hook, link, and chain and sling.
5383 J. Tangye and R. J. Cunnack. Ships, &c., and reducing resistance of friction.
5384 W. Gardner. Machine guns.
5434 W. R. Lake (communicated by G. W. Copeland). Safety valves.
5441 J. A. Stott. Valve gear.
5446 Sir W. G. Armstrong. Ordnance.
5449 W. B. Barker. Sound signalling in fogs.
5454 A. Forbes. Sky lights for ships, cabins, &c.
5455 F. H. Danchell and R. Blum. Ships and vessels.
5458 B. J. B. Mills (communicated by J. H. McLean and M. Coloney). Heavy ordnance.
5459 Idem. Machine guns.
5464 J. Jackson. Prevention of smoke and increase of boiler evaporating power.
5465 W. Atkinson. Raising submerged vessels, &c.
5466 A. E. McDonald. Transfers for freight.
5488 J. Wetter (communicated by B. King). Seat and life-saving apparatus.
5500 J. Gondie. Preventing shifting of cargoes.
5510 J. Sturgeon and J. W. de N. Galwey. Safety valve.
5514 C. A. McEvoy. Torpedoes.
1 G. D. Robertson. Motor for pumping and other appliances on board ship.
16 T. F. Irwin. Screw steamships.
21 O. Wolff (communicated by A. Lehmann). Extinguishing fire on board ship.
27 A. M. Khotinsky. Lime light lamps.
40 G. Petrie. Steam boilers.
45 J. Bodington. Expansion gear.
75 F. Tripp. Metallic packings.
77 D. McCallum. Compasses for iron ships.
98 S. & J. Dawson. Steam generator.
101 J. Lart (communicated by C. W. Doten). Furnaces.
104 J. G. Galley and T. Smith. Hydrostatic marine engine governor.
109 J. H. Barry. Apparatus for lowering and detaching ships' boats.
111 R. G. Sayers. Preventing sinking of ships.
114 W. Legge. Steering apparatus.
131 J. N. Rowe. Valves.
132 S. Lake and T. W. Taylor. Building structures, with subaqueous foundations.
133 S. Lake and T. W. Taylor. Supporting and guiding caissons or dock gates, &c.; applicable also to floating bridges, pontoons, &c.
139 C. Mace. Relieving strains on tow ropes, anchor chains, &c.
146 R. Cundall. Heating feed water.
149 S. S. Hazeland. Rowlocks for boats.
162 T. Rowan. Ventilating ships, &c.
163 H. E. Newton (communicated by N. Barney). Dumping boats or scows.
177 J. Imray. Obtaining motive power from fluid currents.
187 A. M. Clark (communicated by J. McLeod). Masting and rigging vessels.
196 J. A. and J. Hopkinson. Flue tubes for steam boilers.
199 J. K. Kilbourn and G. Fossick. Steering gear.
202 H. A. Bonneville (communicated by F. Brown). Fog signals.
203 J. Dewrance and G. H. Wall. Stop valves.
205 T. J. Rayner. Condensing and distilling apparatus.
242 J. H. Dane. Purifying and heating feed water and condensing steam.
253 C. G. Gumpel. Production of electric currents and application to illumination and transmission of power for steering ships, &c.

⁎⁎⁎ Any information regarding the progress, &c., of these or other patents will be gladly furnished on application.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month.

NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

January 1st, 1881.

Anderson Daniel	1 C	Lvrpool.
Almond John ...	2 C	N Shlds.
Burns Joseph ...	1 C	do.
Bails John R. ...	2 C	do.
Brown George	1 C	Glasgow
Currie Charles D.	2 C	do.
Crawford Wm. ...	2 C	do.
Clare George ...	2 C	Lvrpool.
Crompton Wltr. H.	2 C	do.
Couper John ...	1 C	Abrdeen
Collin George ...	2 C	N Shlds.
Duff Wm. D. ...	2 C	Lvrpool.
Davids Smith W.	2 C	do.
Drummond Francis	2 C	do.
Denison John ...	1 C	London.
Gaddarn Wm. D.	1 C	do.
Goudie David ...	2 C	Glasgow
Grace James ...	1 C	N Shlds.
Ingram Alex. ...	1 C	London.
Jamieson John ...	2 C	Lvrpool.
Jones Wm. J. ...	2 C	N Shlds.
Kirk Charles ...	1 C	do.
Longstaff Robt. F.	2 C	do.
Letton David R.	1 C	London.
Lamont Colin ...	2 C	Glasgow
Mitchell Alxdr....	2 C	do.
McGregor David A.	2 C	do.
Muir James ...	2 C	do.
McClyment W...	1 C	do.
Mathieson Andrew	1 C	do.
Miller John ...	2 C	do.
McLennon Daniel	2 C	Abrdeen
McLean Geo. K.	2 C	Shmptn.
Morgan Rees ...	1 C	Bristol
Pirrie Alexander	2 C	Lvrpool.
Peascod John W.	2 C	do.
Pattison James...	2 C	N Shlds.
Paterson James M.	1 C	do.
Phillips Samuel...	1 C	Bristol.
Robertson Jas....	1 C	Glasgow
Stewart John ...	1 C	do.
Scott William ...	2 C	Lvrpool.
Skinner Thos. A.	2 C	Dundee.
Sinclair Andrew	1 C	Abrdeen
Shepherd Geo. ...	2 C	London.
Stewart James ...	2 C	do.
Shilson Daniel ...	1 C	Plymth.
Thomson Robt...	1 C	Glasgow
White Fredk. J.	2 C	London.
Wright Charles...	1 C	N Shlds.
Wright Ernest N.	1 C	do.
Whyle William...	1 C	Glasgow
Yates Thomas ...	2 C	Lvrpool.

January 8th, 1881.

Banner Saml. ...	2 C	Sndrlnd.
Bell John E. ...	1 C	N Shlds.
Davies David E.	2 C	N Shlds.
Greenfield James	1 C	do.
Gordon Thos. D.	1 C	London.
Hodgson Wm. B.	2 C	do.
Ingram Alxdr. ...	1 C	do.
Landreth Cowen	1 C	N Shlds.
McCulloch Alxdr.	2 C	London.
Morris John ...	2 C	do.
Matthews Wm...	1 C	do.
McWalter Alxdr.	2 C	N Shlds.
Prince Alfd. J. ...	2 C	do.
Parr William ...	2 C	Sndrlnd.
Pegden Nicolas E.	1 C	Hull.
Redhead John G.	2 C	London.
Stutt William ...	2 C	Hull.
Scott John ...	2 C	N Shlds.
Wigg Charles E.	1 C	London.

January 15th, 1881.

Chapman Frncis A.	1 C	London.
Cranston Jas. ...	1 C	Leith.
Fletcher Isaac ..	2 C	Lvrpool.
Harvey Richd. A.	2 C	Plymth.
King William ...	1 C	Leith.
Kissack E. J. ...	1 C	London.
Ross William ...	1 C	Leith.
Swanson Walter	2 C	do.
Sinclair Thos. ...	2 C	Lvrpool.
Thomson Robert	2 C	Leith.
Waters Ebenezer	2 C	London

January 22nd, 1881.

Belliss Edwin ...	2 C	Lvrpool.
Boutflower Thos.	1 C	N Shlds.
Elliott Geo. E. ...	2 C	do.
English Thos. ...	1 C	do.
Haddow Andrew	1 C	Lvrpool.
Hay Alexander...	2 C	do.
Johnson John ...	2 C	Grnock.
Jacks Jas. W. ...	2 C	N Shlds.
Kidd Wm. W....	2 C	do.
Little John ...	2 C	Grnock.
McKay Alxdr. ...	2 C	do.
Major George ...	2 C	Lvrpool.
Robinson Geo....	2 C	N Shlds.
Richardson Jas. J.	1 C	N Shlds.
Russell Robert...	2 C	Grnock.
Riley Charles ...	2 C	London.
Smart Adam G.	2 C	Lvrpool.
Stitt John ...	2 C	Grnock.
Thomas Hugh ...	2 C	Lvrpool.
Thompson Forster H.	2 C	N Shlds.
Thomson John ...	1 C	Grnock.
Wallace Geo. ...	2 C	do.
Watson Jno. Wm.	2 C	N Shlds

ROBERT JACKSON, Registrar-General.

General Register and Record Office of Shipping and Seamen
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NOTICE.

All Contributions and Books for Review should be addressed to the EDITOR, W. G. Neal, 3, Amen Corner, Paternoster Row, E.C. All Communications must be accompanied by the name of the sender not necessarily for publication, but as a guarantee of good faith. The return of rejected communications cannot be guaranteed, nor will the Editor be answerable for the loss of any MSS.

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" " " " treble "	15s
" " ¼ page	30s.
" " ½ "	60s.
" " Whole page	120s.

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SUBSCRIPTIONS.

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The Marine Engineer,

LONDON, MARCH 1, 1881.

EDITORIAL NOTES.

THE necessity for the principle of water-tight compartments in all passenger steamers being rigidly enforced, has received startling illustration from a late accident to the *Caledonia*, one of the London & South Western steamships. This vessel runs with passengers and mails between Southampton and Jersey, and as such a service is a very dangerous one, it would be supposed that the steamers were fitted with such necessary arrangements for safety, as water-tight compartments. This, however, does not seem to be the case. The *Caledonia* struck on the oyster rocks off Jersey, and sunk so rapidly that there was not time to remove the mails. There was a dense fog at the time, which is too frequent an occurrence on the Jersey coast. Many are the hair-breadth escapes in that service that few hear of, and the dangerous nature of the passage is marked by the fact that this is the fourth steamer that the Company has lost in ten years. It is too frequently the case in passenger vessels that the boats are neither ready for immediate use, nor are sufficient to accommodate all the passengers. The passengers may be thankful in this case that the boats were immediately available and sufficient, or a much more gloomy disaster would have resulted. We shall hope to see such reasonable precautions as water-tight compartments rigidly enforced in the case of all passenger vessels. If the Board of Trade Inspection is worth anything it should surely be effective in such matters of life and death.

A BOAT of novel design built by Mr. E. S. White, of East Cowes, has been very successfully tried in the Solent, and approved for torpedo purposes. The peculiarity of the new boat is that its dead wood and keel have been cut away to the extent of one half of its length. This peculiarity does not, in our opinion, add anything to the speed of the boat, in fact, we referred in our last issue to a case in which such diminution of dead wood and altered position of the propeller reduced the effective speed. In this case, however, the position of the propeller remains practically the same, the absence of the dead wood being found efficacious in an increase of speed astern, and increased facility of handling. This shows in remarkable speed of going round. It may often be noticed that in going round the stern of a boat makes little way ahead, and the stern makes a circle round the stem as a pivot. In the ordinary case the keel thus has to push a large volume of water side-ways, and the absence of dead wood in Mr. White's boat materially lessens the resistance of turning, and enables the new boat to turn in a circle one and a half times its own length. The boat is also fitted with a supplementary rudder abaft the screw, which enables her to stop her way almost dead. Her steering powers are also remarkable, as it is found she can circle to port or to starboard in thirty seconds, or one-third the usual time. With the engines going astern the pinnace turned in one and a half minutes. Both rudders are actuated simultaneously by means of gearing, and a double worm which locks the rudders and thus enables the wheel to be left to itself. We consider the improvement equivalent to that of a convex skate compared with a flat one for facility in figuring.

The continued loss of life at successive intervals repeatedly impresses upon all minds the necessity for a good and safe boat-lowering apparatus. There are many now in market which lay claim to these advantages with more or less justice, but our attention has just been drawn to Carpenter's patent, which seems to fulfil the requirements that a reliable boat-lowering apparatus should possess. The gear should be such as to be readily adaptable to the present boat davits and falls, so as to necessitate the least possible alteration to existing fittings. The release should be instantaneous and simultaneous for both ends to meet the requirements of lowering in rough weather and at a time of excitement. The most serious disasters have been caused by one hook being detached before that at the other end. This may easily arise from confusion in a crowded boat, or from the fact of one end of the boat only being water-borne by the crest of a wave. The old fashioned hook could not be released unless the weight of the boat were water-borne. In the gear in question the fall block does not terminate in a hook, but in a togel which can be disengaged by the patent apparatus, whether the weight is water-borne or not. The releasing handles are also both brought to the stern so as to be under control of the coxwain or officer, who can therefore completely release the boat at the moment which seems most suitable to his judgment. Until that moment the boat cannot be accidentally detached by the action of the waves. We hope shortly to illustrate this arrangement in detail, but the foregoing outlined description points out the deserving character of the invention.

Even if the Panama Canal comes to nothing, and we understand that there is a strong opposition scheme supported by the Americans, *via* Lake Micaragna, still it seems that the preliminary survey operations have sufficed to open up a new method of submarine mining. It has been found that the bed of the Atrato River is exceedingly rich in alluvial deposits of gold and platinum. The sands on the banks of the river have already long been washed with successful results in the returns of gold dust, but the bed of the river has hitherto been considered inaccessible. As, however, heavy metals like gold and platinum will naturally gravitate to the lowest depth, there is every reason to believe that the deposits in the bed will be of much greater value and magnitude, and those on the banks. A company of private speculators have developed the method of dredging into a system by which a floating barge sucks up the alluvial deposits from the bed of the river, and discharges and washes them on board. The speculators, we understand, are reaping the profits which their enterprise and ingenuity certainly deserve.

We are glad to hear that at last the Admiralty seem impressed with the invidious distinction at present existing in the Navy, in the shape of separate messes for the engineer and other officers. We have long and persistently drawn attention to this absurd distinction which has long been justly felt as an injustice to those very important officers on board an iron-clad, the engineers. The arrangement in itself is eminently calculated to foster the absurd prejudices and affectation of the naval officers, and on such ground alone should never have been instituted, as heart-burnings and jealousy are the worst possible conditions for efficient discipline and good fellowship. We understand the Admiralty are now about to abolish the separate messes generally, which has already been done in gun-boats and gun-vessels. An order has been received at Portsmouth to extend the system of a general mess to the two corvettes, the *Canada* and *Cordelia*, which are being built. This will be a greater and more welcome boon to marine engineers of education and breeding, than an increase of salary, and is at least an honourable, though tardy, recognition of a most valuable branch of the service.

The *Inflexible* is to be finished at last, within the present financial year if possible. Her fourth 80-ton gun has just been shipped with great success, in the presence of Prince Edward of Saxe-Weimar, Admiral Foley, and other officials. Captain John Fisher, who has been appointed to the ship, joined on Saturday, and as 650 men are now employed upon her, she should shortly be ready for service. She will make a splendid addition to our navy, as she is, with the exception of the *Quilis*, the most powerful ship afloat.

Messrs. Hodgson & Soulsby, iron shipbuilders at Blyth, have got another contract with local owners to build a screw steamer of about 3,200 tons. She is to be so constructed as to be able to suit all trades, particularly for carrying cattle from the States, and will be fitted with all modern improvements. She is to be ready for navigation by September next.

Shipbuilding at Berwick.—At a meeting of Berwick Harbour Commissioners on February 10th the offer of Messrs. Allan & Co., shipbuilders, Leith, for a lease of the shipbuilding yard at Berwick, was accepted. Messrs. Allan & Co., it is stated, intend beginning operations at Berwick at once.

HER MAJESTY'S SHIP "INFLEXIBLE."

THE guns themselves, as already stated, are carried and worked on an hydraulic system similar in many respects to that adopted in the case of the 38-ton guns of the *Thunderer* and *Dreadnought* but with several improvements. The sponging and loading apparatus, which is telescopic and performs its work by two thrusts, is placed at duplicate fixed stations outside the turrets, under the armoured deck, and within cover of the citadel. But as there are no special loading ports in the turret itself, all that is necessary, when the guns have been brought to the loading mechanism in the rear by revolving the turret, is to depress the muzzles to the inconsiderable angle of 9½ degrees, which is all that is required to bring them below the level of the deck, which is, however, raised and inclined upwards at the base of each turret so as to form a sort of glacis, in the trough of which the muzzles are brought under cover. In other words, instead of the guns being lowered to the rammer, the rammer is elevated towards the guns, by which means the necessity for a dangerous and inconvenient degree of depression is got rid of. Another important difference between the tentative arrangements introduced in the other turret ships, and the perfect development of the hydraulic system as fitted to the *Inflexible*, is the novel manner of mounting the guns in the turrets. The usual practice with all heavy ordnance is to place the gun upon an iron carriage, on which it rests by means of its trunnions, together with the mechanism for elevating and depressing the gun, and for tripping the carriage—that is, for throwing the carriage on to wheels so as to facilitate the running of the gun and carriage into battery or firing position—and also, in part, the mechanism for checking recoil. Now, the carriage of a large gun is a lofty and ponderous structure, and occupies much room, a matter of immense consequence in the case of turrets, where the space is inevitably limited. Besides the carriage, however, there is also the slide upon which the carriage runs, which is also of wrought iron, and carries the remainder of the mechanism for checking recoil, as well as the apparatus required for running the gun in and out. But in the system designed for the *Inflexible*, Mr. G. Rendel has taken the bold and original step of dispensing altogether with a carriage properly so called. The guns are mounted in pairs parallel to each other on little brass blocks slipped over their trunnions, aud are made to slide on the top surfaces of wrought-iron beams, which are bolted on to the floor of the turret. By these simple means all the cumbrous and complicated carriage arrangements hitherto in vogue are swept away, while the gun is more steadily and securely carried than ever, with a very material reduction of strain in the working parts. Thus mounted, the working of the guns is accomplished by hydraulic presses fixed upon the same beams which floor the turret and constitute the gun-slides. A press, which is set behind each trunnion block, with piston and piston-rod attached to the block, serves to push the gun out into firing position, and to draw it back into loading position, by the mere admission of water under pressure to one side or the other of the piston. These presses also act as buffers to arrest the recoil of the gun upon the same principle as applied in other ships. The elevation and depression of the gun are accomplished by means equally as effective, certain, and silent. The breech of the gun, which is of the enormous diameter of 6 ft., rests upon a block, which, like the trunnion-blocks, slides as the gun moves in or out upon a central beam in the door of the turret. This third beam, however, is not fixed, but is pivoted or hinged at its rear end, and has its front end carried upon a hydraulic press. Hence, by permitting water to enter or leave the press at the front, the beam is raised or lowered, and the required elevation is thereby given to the gun as soon as it is run out for firing. On the gun recoiling, this block supporting its breech travels back until it comes nearly over the fixed pivot of the beam; and thus, at whatever elevation the gun may be fired, it nevertheless recovers in the act of recoil a given position or angle, which is that required for reloading. Furthermore, since the gun, by this same arrangement, if fired at high angles, is caused to droop its muzzle in the act of recoil, it follows that the gun-port may be made considerably lower than would otherwise be necessary for giving equal power of elevation to the gun. By this means the advantages which are usually attained only by complicated contrivances for muzzle pivoting are secured in a large measure automatically. All the movements involved in working a heavy turret gun are consequently secured by hydraulic presses, than which no mechanism can be simpler, safer, or more trustworthy. In addition to the apparatus for mounting, working, and controlling the guns, there is other hydraulic apparatus for dealing with the ammunition, lifting it to the muzzle, and ramming it home. But next to the manner in which the guns are mounted, the most noteworthy development in the system as introduced in the *Inflexible* is the application of hydraulic pressure to rotate the turrets. In all the other ships which have been fitted with mechanical loading gear the turrets are turned by steam. The hydraulic power is furnished to each turret by a pumping engine, which is placed at a remote and safe part of the ship. The engines work up to 170 horses, and are of the same character as those manufactured by the Elswick firm for the *Duilio* and *Dandolo* and the Chinese gunboat fleet. The power thus generated is applied to turn each turret by two hydraulic engines, one of which is used as a reserve in case of accident. The motive power is transferred to a crank-shaft by three oscillating rams, the plungers of which are 4½ in. in diameter, and have a stroke of 1 ft. 6 in. The crank shaft actuates a pinion which runs in a rack around the base of the turret and turns the mass. The pressure on the plungers is 750 lb. on the square inch, while the pressure of steam at the pumping engine amounts to about 68 lb. The mechanism is so beautifully under control that the turrets can be rotated at any speed from one complete revolution in a minute, with about 40 revolutions of the engines down to a rate as slow and as uniform as that of the minute hand of a clock. As we remarked on a former occasion, the advantage of the high speed is plain, and that of the slow but regular rotation will be apparent when it is remembered how much delicacy of adjustment is necessary for following with the aim an object moving rapidly, but at a distance. The hydraulic turning machinery serves also as a brake to prevent the turret taking charge—that is, turning of itself, as sometimes occurs when the ship rolls heavily; and the water power is led to the turrets through copper pipes, 2 in. in diameter, which are carried up through the centre pivot.

Although the task is not free from difficulty, we must endeavour to describe the progress of the shot and ammunition from the magazines to the muzzles of the guns, and the operations by which the latter are loaded. But, first of all, it will be advisable to state that the guns themselves measure 26ft. 9in. in length, and that the diameter at the largest part is 6ft., the distance from end to end of the trunnions being 8ft. 10in. The bore is 24ft. long, and its calibre 16in., excepting for the last 5ft. in the chamber, which has a diameter of 18in. The size of the projectile varies with the different character of the shell used. Common shell measures 2ft. 11½in. in length, Palliser 3ft. 6½in., while shrapnel and case are 3ft. 9in. long. The weight of each projectile is about 1,700lb. The powder charge, which is divided into three and four parts, consists of 425lb. of pebble, or 450lb. of prismatic powder. The bringing up of such ponderous projectiles and charges from the shell rooms and magazines and their ready control require special appliances, and here again hydraulic power has been called into play. Eighty rounds are carried on board for each gun, amounting in the aggregate to about 243 tons of shell and 64 tons of powder. For the purpose of storing these enormous quantities a shell-room and magazine have been built and fitted at each end of the ship below the 3-inch armour deck, the one pair supplying the fore-turret and the other the after-turret. The appliances for handling and transporting the ammunition are very efficient. Each shell room is divided into a number of compartments, the projectiles being stored upon each other. The gas checks are also carried in the shell-rooms. Opposite each compartment, and attached to the side of the room in the passage way, is a hand which, with chain passing over a roller, which travels on an overhead rail. After a projectile has been raised by the winch it is lowered on to the trolley which has its base inclined to an angle of 9½ degrees, that being the angle to which the guns are depressed when they are brought to the loading position. In loading the trolley, care is taken to drop the shot over a stud, which prevents it from sliding, but is capable of being tripped down as the projectile is forced in the opposite direction. A copper gas check—which is used to prevent windage and give rotation to the projectile—is next attached to the shell by a tool having a screw and triple clip, which grasps the gas check and burrs it over a projection at the base of the shell. In the meantime a powder case containing the charge has been transported from the adjacent magazine to the door of the shell-room by means of an overhead travelling arrangement, and bolted to the cover of the trolley above the projectile. The cartridge and shell having been thus placed upon the same truck, the freight is passed to the deck above by means of a hydraulic lift moving up an inclined plane. We have all along spoken of a single charge and shell, but while the one trolley has been receiving its load a precisely similar operation has been taking place close at hand, so that each hoist of the lift up to the citadel provides the supply for loading the two guns of each turret. Reaching the loading station, the trolley is next run upon a hoist under the muzzle of the gun, the course of the trolley along the deck being defined by rails from which it cannot escope. It is also controlled by a simple form of brake, so that it can be run about the decks without regard to any rolling of the vessel. By the simple motion of a lever the hydraulic pressure is applied, and the lift automatically rises until the powder is in line with the axis of the gun, which is the position required for transferring it into the bore. Another lever is touched, and a telescope rammer, which works in horizontal guides under the armour decks, drives the charge into the mouth of the gun and is instantly withdrawn. The great length of the cartridge and shot combined is too unwieldy to enable them to be placed in the same line; and as two strokes of the rammer are required to complete the loading, it would be mere waste of time to ram the powder home by itself. It is, therefore, merely introduced by the first thrust, after which the hoist is lowered a short distance to unbolt and enable the powder case to be removed. By a reverse action of the same lever to that which previously caused the hoist to rise, the projectile is now borne to the muzzle, and the rammer moves forward until the indicator shows that both the charge and the shot are home. A man close at hand now signals to the gunner inside that the right or the left gun is loaded, whereupon it is run in for a short distance and elevated, the locking bolt is withdrawn, the turret is rotated in the direction of the target, and the gun is run out over the side, elevated or depressed as the case may be, and fired. From the foregoing it will have been observed that all the four guns can be loaded in the same time which it would take to load one, the various operations being performed by separate detachments simultaneously.

After firing the gun is brought back to the loading position for recharging. But before this is done it is necessary to sponge it for the purpose of destroying all the smouldering particles which may be left behind in the chamber. This operation is performed by the rammer which is fitted in the head by a projection or button. As this projection is forced against the end of the chamber with a force of 300lb. pressure a valve is opened whereby a copious stream of water is projected into the gun and thoroughly cleanses it. But as this action is wholly automatic, it is evident that the same syringing would ensue in the act of loading if special means were not taken to prevent it. This is effected by the wad which is used to remove the possibility of the shot following the rammer, and which, being recessed in the centre, allows the button to enter without pressing against the projectile. In order to provide against the possibility of a breakdown of the gear in action, all the vital parts are duplicated. Each turret is provided with an engine for accumulating the hydraulic power, which can be worked interchangeably so as to supply both or either turret with the necessary pressure. The turning engines are also duplicated, each turret having a pair connected with separate or duplicate racks. And lest any accident might occur to the steam machinery by which the hydraulic pumps are worked, hand pumps have been provided by which manual labour could be substituted for steam. These hand-pumps are fitted as force pumps like the pumps of ordinary fire-engines, and are available, in case of emergency, for turning the turrets and performing all the movements connected with the loading and training of the guns. The *minimum* of liability to injury or derangement, whether of the source of power or of the mechanism by which the power is applied, seems to be attained by this hydraulic system. Of course, the 80-ton gun becomes, like the ship's engines, a machine, and can no longer, as in the case of the 38-ton gun, be worked as an alternative by hand-power alone. This consideration lets in those objections which seem natural in the mouths of zealous and trained seamen who know what sailors can do, and how readily they can be replaced in action when machinery cannot be repaired. Every one, however, will now see that it is hopeless to attempt to work 80 and 100-ton guns on board ship by manual appliances. But what has not yet been as evident as perhaps it should have been, is the fact that for a long time past, in the instance of guns much less weighty, hand power has been invariably supplemented by complex mechanical adjuncts without which the gun could not be handled. In such cases have been realized all the respective disadvantages of hand labour and machine labour, and the full advantages of neither. The true limit of the strength of this compound system has, of course, been its weakest point, and the weakest point has always been excessively weak, because in a mixed system, and where mechanical ingenuity is fettered by the necessity of retaining the use of the hand power, there are necessarily introduced multiplying, complex, and puny forms of mechanism, such as are most readily disordered. In truth, when once mechanical appliances become necessary to eke out hand power, it would seem better to abandon hand power altogether as the source of power, and to go straight to mechanics, not in aid of hand power, but as a new source of power. Thus only will be given to the mechanism full and free scope in devising the simplest and most direct application of mechanics. When it is seen, as there is reason to believe was seen during the trial of the *Inflexible*, how simple, solid, and safe the mechanical arrangements required for mounting and working heavy guns may be, if only the source of power be mechanical, some regret will be felt that it should not be until now, when we happen to have reached a size and weight of gun with which it is ludicrous to suppose that hand power could deal, that the mechanical engineer has gained his opportunity in the service of applying mechanical principle unembarrassed by the old sentiment in favour of hand power. The whole of the machinery was supplied by Sir W. Armstrong & Co., but it has been fitted in place by the dockyard artificers under dockyard supervision.

NESBIT'S SAFE CHEQUES.

SECURITY against the possibility of tampering with the amounts of signed cheques is a desideratum strongly to be wished for by all commercial houses and bankers. The facility with which chemical experts can remove writing in ink is far too little appreciated. As it happens, writing ink is a compound of organic acids, of a very unstable nature, for which there are innumerable solvents, and there is a large choice of reactions in the hands of the forger.

At present bankers rely upon the protection afforded by what they consider a sensitive colour for the fine line printing, and further in some cases on a design on the back of the local part where the amount is written in ultramarine blue or an impregnation of the whole of the paper with Prussian blue. To an amateur, these three protective colours may offer an apparently insuperable difficulty to tampering with the writing with any solvents whatever; but we understand that an expert in chemcial science would still be at no loss to dissolve ordinary writing from a cheque protected as described, or protected in any way with only one or more isolated chemical re-actions. Thus if a forger finds that a solvent of the ink dissolves out the fine lettering of a cheque, it is easy to test with other solvents which shall have no effect on the line printing, or he may use suitable mordaunts to fix the fine line lettering before commencing. Again, if he should find that by the application of certain chemicals, a stain is developed that was previously invisible, it is an easy matter for him afterwards to dissolve out the stain or restore it to its original condition after the the writing has been removed. These statements can be practically proved, we understand, so as thoroughly to demonstrate the insufficiency of the present chemical protection to cheques.

Mr. Anthony Nesbit, F.C.S., has, however, originated a method of printing which is extremely simple, and seems satisfactorily to defy the most expert chemical manipulation to tamper with it without destroying the fine line printing, which it is then impossible to reproduce or restore. The essential principle is founded on the fact that, to dissolve writing ink, it is necessary to use a solution either slightly acid or slightly alkaline.

Mr. Nesbit therefore makes his cheque by using a dye, which is effected both by acids and alkalis, but which is one colour in acids and another in alkalis. The line printing is done partly in an acid and partly in an alkaline ink, which may be colourless or of any colour in itself, but which produces the colour in the printing due to its acid or alkaline re-action respectively upon the ground dye of the paper.

If then the cheque was subjected to a dilute acid solution for the dissolving of the ink, the whole cheque, printing and all becomes of the acid colour of the body dye, and the inscription cannot be regained, as any further treatment by an alkali will simply alter the whole colour of the cheque and printing to the corresponding alkaline colour. The *vice versa* action ensues if an alkaline solution is used in the first instance followed by an acid solution for attempted correction. As all solutions must be acid, alkaline, or absolutely neutral, of which last character there are no solvents of ink at present known, this arrangement seems to be an absolute security against chemical forgery.

Should, however, a neutral solvent of ink be eventually discovered, a protection against tampering can be effected under Mr. Nesbit's system, by making the acid part of the printing stronger than the alkaline part, or *vice versa*. In such case, a neutral solution would produce a complete blurring of the document. As oxalic acid is applicable to this method of printing, any species of type can be used. A cheque so prepared, will be extremely cheap, as its security no longer depends upon the fineness or special character of the type or printing. Special chemicals used to prevent local alteration can still be used in Mr. Nesbit's inks. This seems certainly to be the only perfect method of chemical security for cheques, and to be of an exceptionally cheap and simple character.

ON THE EXPERIMENTS WITH THE PERKINS MACHINERY OF THE STEAM YACHT "ANTHRACITE."

From the Journal of the Franklin Institute.

By Chief-Engineer Isherwood, United States Navy

(*Continued from page* 257.)

Experiment made at the New York Navy Yard with the Machinery of the Steam Yacht "Anthracite," to Ascertain its Economic Development of Power.

THE following table contains the data and results of the experiment made by the Board of Naval Engineers on the machinery of the steam yacht *Anthracite* to ascertain its economic development of power, the vessel being secured stationary to the wharf of the New York navy yard. For facility of reference the quantities have been arranged in groups, and the description of each is so full that but little additional explanation is required.

The experiment continued, uninterruptedly, 23 hours and 58 minutes, during which all the conditions were maintained as uniformly as possible. The machinery throughout this time was operated by Mr. Perkins' engineers and fireman in the manner which their experience had taught them would produce the highest economic results.

The fuel was semi-bituminous coal from the Cumberland mines in Maryland, and was rather below the average quality. The experiment was commenced with a clean fire in full action, after the machinery had been several hours in operation, and was ended with the fire in the same condition as regards cleanliness and thickness as nearly as could be judged by the eye. The coal was accurately weighed on shore into bags of uniform weight and delivered on board as required, the bunkers of the vessel having been previously sealed. The time of emptying each bag was noted in the steam log or engine room record. The fire was kept well cleaned, levelled, and free of holes; and all the refuse from the coal, in ash, clinker, soot and dust was carefully weighed in the dry state.

The quantity of feed water pumped into the boiler during the experiment was accurately measured in two iron tanks placed on the vessel's deck, and filled alternately by the water of condensation delivered from the condenser by the air pump. At the end of the experiment, the level of the water in the glass gauge of the boiler was made the same as at the beginning, and the quantity required for this purpose was measured in the tanks with the rest. The weight of water was calculcated from the carefully measured contents in cubic feet of the tanks, the number of tankfuls emptied, and the weight of the water per cubic foot at the temperature it had in the tanks. The exact time at which each tankful was emptied was noted in the steam log.

The number of double strokes made by the pistons of the engine, or revolutions of the main shaft, were given by a counter worked by the engine, the number on the counter being entered half-hourly in the steam log.

The steam pressure in the boiler and in the receiver was noted from gauges in the engine room, and entered half-hourly in the steam log, as well as the vacuum in the condenser, and the height of the barometer. The throttle valve was carried wide open during the entire experiment. At half-hourly intervals the temperatures were noted of the external atmosphere on deck, of the air in the engine room, of the injection or sea water, of the water discharged overboard by the circulating pump, of the feed water in the hot well, and of the feed water in the tanks. The following table contains the means of all these half-hourly observations. The temperatures given in the table of the steam in the boiler, and in the first cylinder at the commencement of the stroke of its piston, considered as saturated in both cases, are calculated from a formula deduced from the experiments of the French Academy and of the Franklin Institute.

During the experiment, a complete set of indicator diagrams were taken every half-hour, the means from all which are given in the following table. Four indicators were employed, and they remained permanently in position, attached to the cylinders by short straight pipes. A set of diagrams comprised one from the top of the first cylinder, one from the bottom of the second cylinder, and two respectively from the top and bottom of the third cylinder. There were taken in all one hundred and ninety-two diagrams.

The point at which the steam was cut off in the first and third cylinders, respectively, was obtained from the diagrams and corresponds to the point of inflection between the throttled and expansion curves.

The pressures in the cylinders are the means given by all the diagrams, which were measured for the pressure at the commencement of the stroke of the piston, at the point of cutting off the the steam, and at the end of the stroke of the piston, all above zero or the line of no pressure as given by the barometer. The mean back pressure against the pistons during their stroke, and the back pressure at the commencement of the stroke, are given, both above zero, the latter back pressure is the minimum in the cylinder. The indicated pressure, representing the mean ordinate of the diagrams, was obtained by a planimeter. The net pressure given in the table is the indicated pressure less two pounds per square inch of pistons allowed for overcoming the friction *per se* of the moving parts of the engine. What is called the total pressure on the piston is the sum of the indicated pressure upon, and of the mean back pressure against, the piston during its stroke.

Some explanation may be required as to the calculation of the various horses-power given in the table, and the uses made of them. Of course, the indicated and the net horses-power developed in the different cylinders are calculated from the entire areas of their respective pistons and for the indicated and net pressures upon them. The total horses-power developed in the first cylinder are also calculated in the same manner from the total pressure on the piston and from its entire area. The total horses-power developed in the second cylinder, while calculated for the total pressure upon its piston per square inch, are not calculated for the entire area of its piston, but only for the annular space remaining after the area of the piston of the first cylinder has been deducted from the area of the piston of the second cylinder. In like manner, the total horses-power developed in the third cylinder is not calculated for the entire area of its piston, but for only the annular superfices left by the subtraction of the area of the piston of the of the second cylinder from the area of the piston of the third cylinder, and for the total pressure upon that superfices in pounds per square inch.

In the compound engine, the back pressure overcome by the piston of the small cylinder is more or less utilized upon, or transferred to the piston of the large cylinder, where, for a superficies equal to the area of the piston of the small cylinder, it develops a pressure equal to the sum of the indicated and back pressures per square inch upon the piston of the large cylinder. Thus a portion of the indicated horses-power developed *in* the large cylinder is really developed *by* the piston of the small cylinder. The only portion of the indicated horses-power developed *in* the large cylinder that is developed *by* its piston is what is due to the remainder of the area of that piston after subtraction of the area of the piston of the small cylinder. And the total horses-power developed by the piston of the large cylinder is what is due to the annular superficies left by the above subtraction and to the total pressure upon it composed of the sum of the indicated and back pressures upon the piston of the large cylinder per square inch.

The total horses-power represents the entire dynamic effect produced by the steam, and, in the compound engine, as in the simple engine, would be the sum of the indicated horses-power developed in the small cylinder and in the large cylinder, and of the horses-power required to overcome the back pressure against the piston of the large cylinder, the latter power being calculated for the entire area of the piston of the large cylinder and for the back pressure against it in pounds per square inch above zero, were there no loss of pressure due to the transfer of the steam from the small to the large cylinder, but as there always is such loss, it amounts to its value of back pressure against the piston of the small cylinder not utilized as pressure upon the piston of the large cylinder. With the same back pressure against the piston of the large cylinder of the compound engine as against the piston of the simple engine, and with the sum of the indicated pressures on the pistons of the compound engine reduced to the area of its large piston, equal to the indicated pressure on the piston of the simple engine, there will always be a less proportion of the total pressure utilized in the compound than in the simple engine. In the compound engine, then, the total horses-power is the sum of the indicated horses-power and the horses-power required to overcome the back pressures against the pistons, calculating the latter power separately for each piston. It is essential to know, not only the total horses-power developed by the engine as a whole, but the fractions of that power developed by the piston of the small cylinder and by the piston of the large cylinder; because, in calculating the weight of steam accounted for by the indicator at any point of either piston after the closing of the cut-off valve, it is necessary to know not only the pressure of steam at said point, but also the total horses-power which have been developed up to that point by the expanded steam alone, that is, by the steam after the closing of the cut-off valve, the weight of steam condensed in the cylinder to furnish the heat transmuted into the total horsespower developed by the expanded steam alone having to be added to the weight due to the pressure at the given point.

(*To be continued.*)

ERRATUM in February Number, page 253, "was reprinted in the September Number of this Journal for 1880," should read "will be reprinted in the April Number of this Journal for 1881."

WHAT IS THE MOST ECONOMICAL POINT OF CUT OFF FOR STEAM ENGINES?

By W. KILVINGTON.

AN article under the above title appeared in this paper last month by Professor Marks, in which some conclusions were arrived at, which, for the benefit to your readers, ought to be examined more closely.

The investigation there entered into can be stripped of mathematics—which it will be advisable to do, so that all your readers can judge of its merits—and represented by a diagram.

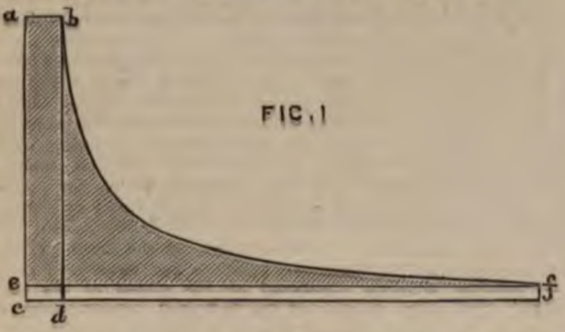


FIG. 1

Let Fig. 1 represent a theoretical diagram showing the expansion of a volume of steam *a b* or *c d* at the absolute initial pressure *a c* or *b d*, and cut off instantaneously at the point *b*; if *e c* is the back pressure, the effective work done on the piston will be the shaded portion of the diagram *a b f e*, and the greater this is the greater will be the work which will have been done by the steam *a b c d* used. Now it is evident that as long as the expansion line *b f* keeps above the line of back pressure *e f* some effective area is added to the diagram; so that to get the greatest effect the expansion must be carried on till the curve cuts the line *e f*. This is the solution of Professor Marks—neglecting his wrong assumption as to the form of curve—in other words.

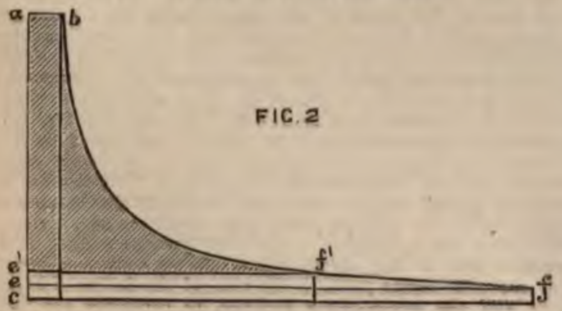


FIG. 2

Passing over, however, for a moment, the consideration of the nature of the curve of expansion of steam, is the above a true conclusion? Very little thought shows that it is not. Is the back pressure (which is taken at 3 lbs.) the only *resistance* to be taken account of? On the contrary, it will be found that there is friction of piston and of other parts of the mechanism which referred to the piston have together, say, the effect of other 3 lbs.—not an excessive amount—then the line *e f* must be moved up to *e' f'* (Fig. 2) making *e' c* = 6 lbs., and the useful effect here is the shaded portion, *a b e' f'* so that the expansion ought to have been stopped at *f'*. Then, instead of having, as in example given, fraction of cut-off $e = \frac{3}{45+15} = \frac{1}{20}$ we have $e = \frac{6}{45+15} = \frac{1}{10}$

Again, the hyperbolic curve—however convenient in calculation—does not even approximately accord with the curve for saturated steam, which is the nearest to it. So that instead of the volume of steam varying inversely as the pressure, as assumed by Professor Marks, it is found by referring to the curve for saturated steam, that steam expanding from 60 lbs. absolute to 6 lbs. absolute does not expand 10 times, but only about $7\frac{1}{2}$ times. This causes a further correction to be made in the value of *e*, from $e = \frac{1}{10}$ to $e = \frac{1}{7\frac{1}{2}}$

But *e* must actually be again corrected, (see Fig. 3).

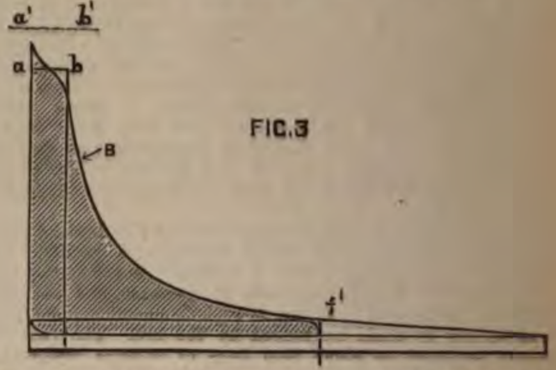


FIG. 3

It will be noticed that the mean pressure of admission *a b* in the representation of an engine diagram shown by the shaded lines, is the pressure to be considered, and this is *not* the "gauge" pressure. The boiler pressure to give the pressure *a b* would really be $\frac{1}{10}$ to $\frac{1}{8}$ higher, as shown by *a' b'*. That is to say that in the example 45 lbs. (*a' b'*) ought not to have been taken, but some lower pressure (*a b*). The Professor does not say whether the "cut-off," that he speaks of, is *effective* cut-off or cut-off *by the valve*; if he means the latter (and there is nothing to show that he does not) yet another correction must be made, for the former cut-off is the point *b* while the latter is at some part of the curve, *B*.

It may be advisable to comment on these two last-mentioned points at greater length on some subsequent occasion; let it suffice for the present to say that the variation depends chiefly on the velocity of piston and opening of steam-ports.

A final word now as to the value of *e*, which we have been discussing, and which Professor Marks says, as found by his method, is "exact enough for all ordinary practical purposes." Well, it will be found, when all the alterations and corrections herein indicated have been made, that it is in error, at least, to the extent of 200 per centum!

ECONOMICAL CUT-OFF IN STEAM ENGINES.

By S. W. ROBINSON.
Of Department of Mechanical Engineering, Ohio State University.

THEORETICALLY the most economical cut-off is readily seen to be that by which the steam at the instant of release has, in the particular cylinder, and under the particular conditions, no capacity for developing further work.

In a cylinder of indefinite extent, having one fixed head and a moving piston between which steam has been admitted to a certain point, then cut off and expanded, the best point theoretically, at which to release the steam will be where the pressure has fallen by expansion to the back pressure. This is evident from the fact that up to this point there is an effective pressure upon the piston to urge it forward, while beyond this point the effective pressure is backward, or prejudicial. An indicator card taken from an engine working under these conditions will have a sharp point at the end, or termination of stroke. If the atmosphere is the back pressure, as in case of non-condensing engines, then the release occurs where the expansion pressure equals one atmosphere. In condensing engines it is where the expansion pressure equals the pressure of the condenser, where the back pressure is zero, if possible, it is where the volume of expansion is infinite. For this latter case the above ideal cylinder must be of infinite length.

For all the above cases, the ratio of expansion is equal the pressure of admission divided by the back pressure, where Mariotte's law of expansion holds; since, by this law, initial pressure × initial volume=final pressure × final volume. Or,

$$\frac{\text{initial pressure}}{\text{final pressure}}=\frac{\text{final volume}}{\text{initial volume}}=\text{ratio of expansion.}$$

This result agrees with that obtained analytically by Professor Wm. D. Marks in the February number of this Journal, where the simple rule for finding the most economical point of cut-off, *stated in words as that by which the terminal pressure must equal the back pressure*, was looked for without success. According to this rule, the indicator card shows at a glance when the specified adjustment is realized.

This adjustment of the cut-off is pretty generally accepted by engineers as the best *theoretically*. But in actual steam engine practice the adjustment will be quite different, for several reasons, such as excessive size of cylinder, causing loss by radiation of heat and cooling by expansion, friction by mechanism, undue strains of parts or increased piston speed, etc. For instance, the size of the crank pin enters into the problem. In practice, the indicator diagram from an engine running under the most favourable conditions, or with the most economical practical cut-off, should show its narrow end cut square off with some considerable breadth, instead of being absolutely sharp; and what breadth it should have is a matter not easily determined. To illustrate, take an example of a non-condensing engine working under 90 pounds absolute pressure of admission per square inch, cutting off at one-fourth the stroke. The terminal pressure will be 7½ pounds above the atmosphere, Mariotte's expansion; but if the cylinder were 50 per cent. longer, the terminal pressure would be just the atmospheric, or that required by the solution given by Professor Marks. The gain in work done per stroke, for the 50 per cent. longer cylinder, will however be, as found by calculation, less than 4 per cent. of the work done without the 50 per cent. added.

To save this 4 per cent., the engine, for a given establishment, would require to be one-half larger, making the same number of strokes per minute. Or, if the number of strokes diminish with increase of size, it would need to be more than a-half larger. Aside from the considerations of greater loss of heat by radiation, cooling of steam, friction, etc., there comes the interest to be paid on the additional investment required in the larger engine. In the light of considerations like the above, which must be familiar to professional as well as practical engineers, it would seem that the qualifications needed to the last sentence in Professor Marks' article must, through some hurry or otherwise, have been overlooked, but which, it is hoped, will be fully supplied in the article promised soon to follow.

INDESTRUCTIBLE PACKING.

PACKING in glands is one of the items in engine maintenance that most tries the temper and patience of the engineer. There is nothing more annoying than a packing which at one time is always blowing, and then by further tightening becomes hard and non-elastic, and grips the rod as the pressure is increased. In the cases of high pressure, and consequent temperature, all these troubles are manifoldly increased. Hemp or flax chars and crumbles, and is blown by the steam out of the box.

The Indestructible Packing Company has for many years been introducing a packing which certainly fulfils the conditions of a high pressure packing. It is formed of copper wire in a peculiarly woven sheet wrapped upon itself until it forms a rectangular ring cut through at one point. This ring of packing has great elasticity both in itself and as a ring ,when packed in the stuffing box there must be a small space left between the cut ends to allow of elastic movement. The gland must only be tightened up by thumb and finger pressure on the nuts, not by spanner as in the case of hemp. If there is any slight blow at first under these circumstances it will soon afterwards disappear by wear, so that there is very little attention required. After the packing has become tight, it must not be touched, and under such circumstances will wear for years with proper lubrication. The company have supplied glands which have not been touched with a spanner for over seven years. We see they are so confident of the indestructible character of their packing, that they in one case guarantee the packing to last as long as the engine, if treated on the principle of leave well alone. Even when worn out, the packing can be resold for old metal.

CORNISH'S LIFE SAVING APPARATUS.

THE apathy of shipowners to the means of saving life is difficult to understand. We cannot but think that an appreciative public would amply renumerate any enterprizing shipowners who would give evident and special guarantees of life saving apparatus being to hand in case of sudden disaster. Without wishing to be hard upon shipowners, we certainly would consider that jurors on a coronor's inquest upon drowned passengers should strongly animadvert upon the neglect of shipowners to supply such fittings for the security of life as are well known to be efficacious for the purpose. Mr. Cornish, an Australian inventor, seems to be energetically pushing as Cornish & Co., of 109, Fenchurch Street, a very excellent life saving apparatus, under the notice of passengers and shipowners. The invention consists of a special stuffing for mattrasses, cushions, or pillows, of an elastic fibrous material, which is sufficiently light to confer great buoyancy in the water to all objects stuffed with it. The practical value of such an invention is self-evident. There must always be as many mattrasses, hammock mattrasses, pillows, or cushions, as there are individuals on board ship, and as each mattrass, without reckoning pillows, &c., will support one individual in the water, every man, woman, and child on board, may be thus supplied with his or her own life buoy in case of sudden foundering, without reckoning upon aid from the boats at all. In the case of a man-of-war suddenly foundering, after all her boats had been damaged by shot, immediate means of rescue would be thus supplied to the crew. In such a case as the *Princess Alice*, carrying a large number of passengers in a pleasure party, the whole of the passengers might have been saved if the seats and berths had all been cushioned with Cornish's Patent Life Saving Appliances.

Not only, however, does Cornish's mattrasses commend itself to our notice as a perfect life saving apparatus, but also from its qualities of economy in first cost, being no dearer than present mattrasses, from its comfort in use and from the cleanliness and wholesome character of the stuffing, which will not harbour vermin. If desired, the mattrass may be a combination of the floating fibre, and of horse-hair, or of the floating fibre alone.

The adoption of cushions of such material on board passenger boats and vessels would be a perfect life-buoy, which could be made of instanteous service by any by-stander for the saving of life of any person fallen suddenly over board. We cannot but think that these cushions and mattrasses only require to be known to shipowners to ensure their immediate adoption in new vessels at least, as cushions and mattrasses of some sort must be provided, and if so, Why not the best? Their more general application to passenger vessels already running, is only a question of time, and the pressure of public opinion on behalf of passengers.

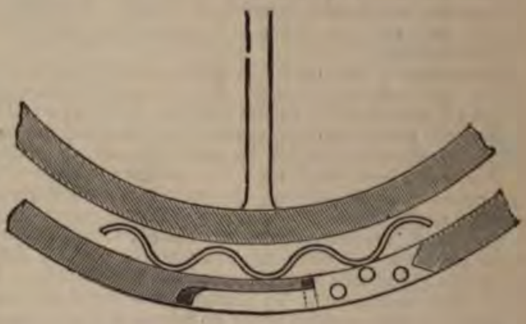
THE EMPRESS OIL LAMP.

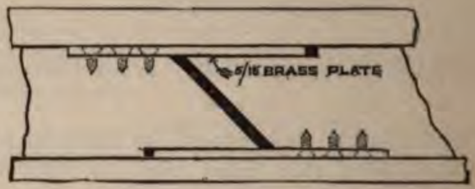
At last the many improvements in oil lamps have resulted in the entirely novel and useful result of a lamp which will burn with a pure white light and no smoke, without chimney of any kind. This is a great boon to all users of oil lamps, particularly on ship-board, as the breakages of chimneys is always a considerable source of loss, and to a greater extent of inconvenience. Should a chimney be broken in an ordinary lamp, and another not be found, the lamp is thereby rendered useless until another chimney is procured. In the case of a voyage this may be a long time. In other respects there seems to be especial advantages attaching to the "Empress" Lamp as supplied by Messrs. A. Phillipson & Son, of 7, Water-lane, Queen Victoria-street, E.C. The oil is kept especially cool by a current of air round the cistern so as to obviate all danger of explosion. The light is perfectly steady, and a pure white, whether turned high or low, and is especially valuable for pleasant reading and the discrimination of colours. As the combustion is so complete they do not blacken ceilings as in paraffin or other lamps of gas. The lamp in construction is simple and pretty, and eminently adapted for use on board ship.

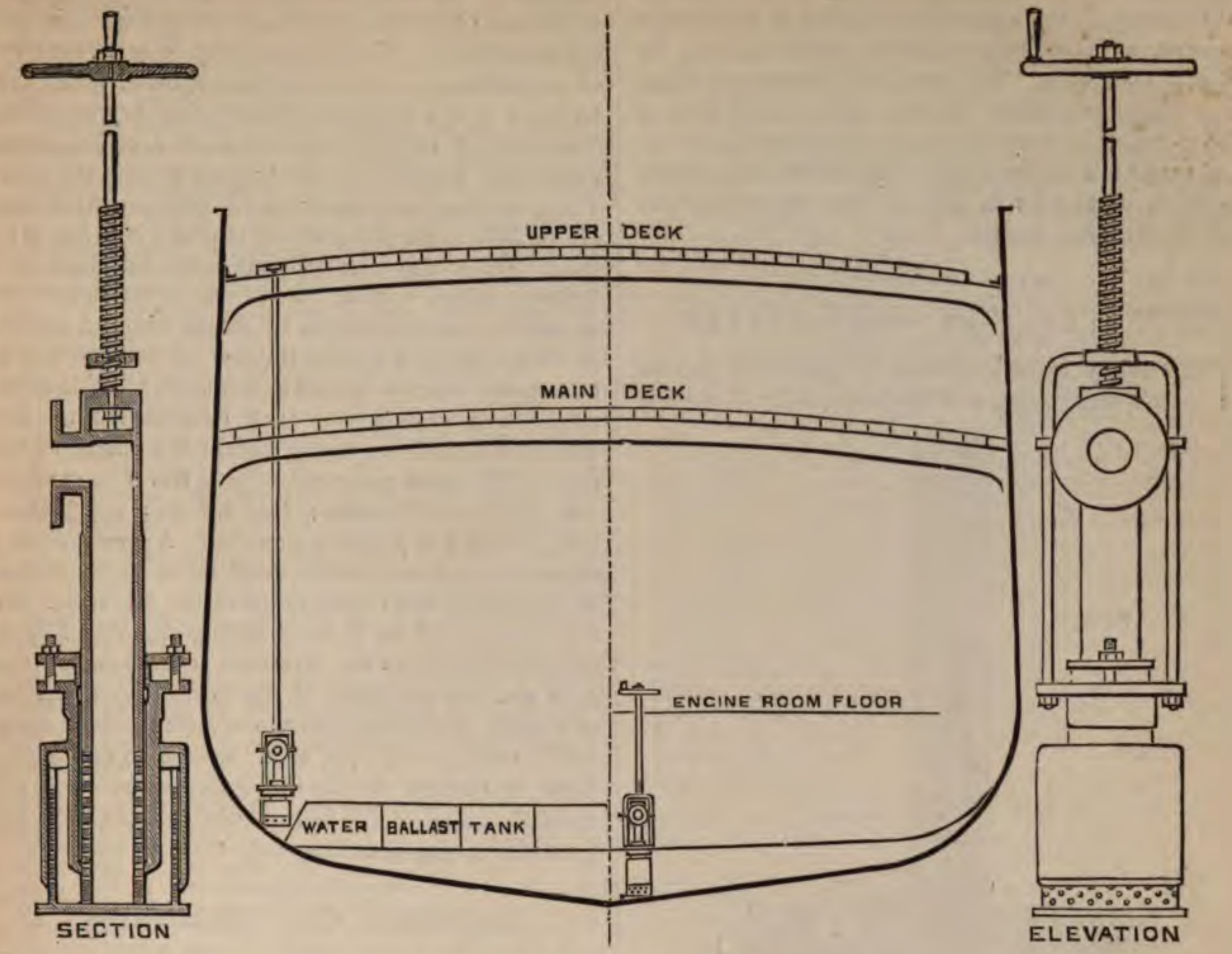
"Duchess of Edinburgh."—This steamer, which plies between Dover and Calais, arrived at the Tail-of-the-Bank about noon, on February 16th, and proceeded up to Glasgow, where an overhaul of her engines is to be made.

CAMERON'S PATENT PISTON SPRINGS.

Very few steam-ship owners realize the large proportion of loss of steam sustained from the leakage past large pistons. This loss is saved by attention to the packing of pistons, and the use of good packing rings. We illustrate a section of Cameron's Patent Spring as supplied by Messrs. C. S. Mallet & Co., of 9, London-street, Fenchurch-street, E.C., which has acquired a good reputation during the last three or four years for being an excellently tight packing and very economical in wear. The speciality of the packing consists in the peculiar spring used to produce the outward pressure of the ring. Any ordinary packing ring can be used, but in such case the ends of the rings must be fitted with brass overlapping pieces as shown, to prevent a blow through the joint. The spring is in the form of a wavy corrugation inserted between the piston groove and the ring which it thus presses outwards with a uniform pressure. The ends of the spring should just meet inside the packing ring, and then liners must be put in between ends equal to one-tenth of an inch to every ten inches of the inside of packing ring. The inside of the waves must be at least $\frac{1}{4}$-inch clear of the body of the piston, and the liners should fill the space between body of the piston and the packing loosely so as not to work out. Pistons so fitted are adjusted by rule which has been deduced from many years' practical experience, and are thus rendered steam-tight without unnecessary frictional pressure on the cylinder. The result is easy working, economy of steam and lubricant, as the light pressure makes the oil go farther.







NORTON'S PATENT UNCHOKEABLE STRUM BOX.

IMPROVED STRUM BOX.

ONE of the most embarrassing things that can occur in a sudden emergency of leakage on board any vessel is for the suction pipes of the bilge or other pumps to become choked by grit, dirt, waste, or other *debris*. This is a frequent occurrence on board cargo vessels, and as such suction strums are at the most inaccessible portions of the hold under water, the difficulty of getting at them may be well imagined. The invention we illustrate is a so-called unchokeable strum box, patented by Mr. Norton, of Newcastle. The strum consists of a double casing of perforations, sliding on the outside of each of which is a double case of box. This box slides on the suction pipe with a gland which can be packed water-tight, and the covers are moved up and down by a screw and hand wheel. This hand wheel may be fixed at any convenient point on any deck, so that the strum boxes may be worked without descending to visit them at all. In the event of the lower holes becoming choked whilst pumping, the strum box is lifted so as to uncover a further row of holes. This may be repeated until the whole surface of the outer box is choked. The cases are then screwed close down, and by the shearing action of their lower knife edges they remove any obstructions that may be collected round the outside of the boxes.

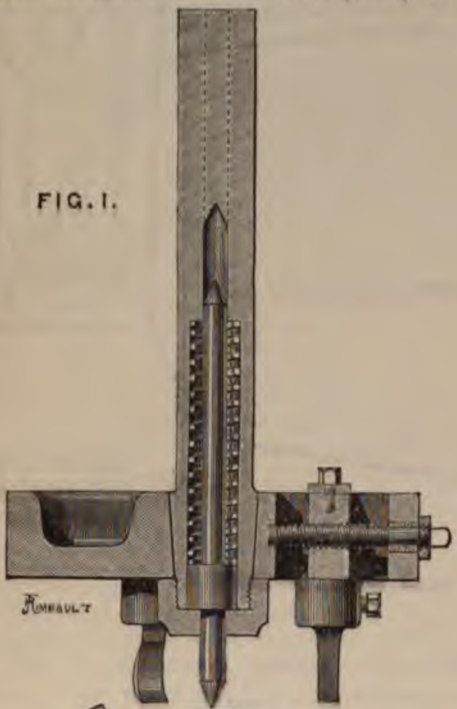
When not in use the cases are kept screwed down, so that there can be no silting or filling up of the holes whilst standing still. The strum box is also perfectly water-tight when screwed down, and the interior of the pumps and valves can thus be examined with ease.

We see that most satisfactory trials have lately taken place at Newcastle with Norton's Patent Strum Box, which seem to have fully established its claim to the term unchokeable. In order to satisfy those asked to investigate the results, the orifices exposed in the strum were absolutely choked with clay. By the raising of the cover a further row of holes were opened, and the pump was thus enabled to draw its supply with ease. The tank was filled with ashes and with cotton waste without choking the draw of the pump, even when the pump, was drawing half air and water in shallow water. The result was all that could be wished for in proving that the strum was practically unchokeable.

BENNETT'S TUBE PLATE CUTTER.

THE injury to boiler plates by punching is now well recognized, and the best quality of work is that in which all are holes drilled. We illustrate herewith in elevation and plan an improved tool for cutting out holes in tube plates. It can also be applied to the cutting out of wrought iron flanges, in in which case the outer and inner ring are cut simultaneously. The tool, as may be seen, consists of a circular plate upon a vertical spindle, which can be fixed in any required position or on any machine. The vertical spindle terminates in a coned centre which thus runs in a centre punch hole in the plate. There is thus no necessity to drill a preliminary central hole in the place where the tube hole has to be cut. Upon the circular plate are fixed three tool holders, which can be caused to travel nearer to, or farther from the centre, by means of radial screws, on which the tool holder travels. If a flange has to be cut out, six sets of cutters are used, three in each ring. The cutters can thus be adjusted to any size of tube-hole or flange within the limits of the tool. The tools are made in sets, No. 1 to cut from 2 to 3¼ inches diameter; No. 2, from 3 to 5 inches, and 3, from 5 to 7 inches diameter. A special feature of the tool is, that its weight is all taken on the centre, so that there is no dead pressure on the tools, the tool is supported on a spiral spring, its rate of feed can be adjusted to the hardness or softness of the plate and the sharpness of the tool. The formation of a truly cylindrical hole can always be relied upon, and a saving of 20 per cent. in time on each boiler plate is claimed by the inventor. The tools are specially prepared for high speeds, so as to allow the greatest rapidity of cutting out.

FIG. 1.



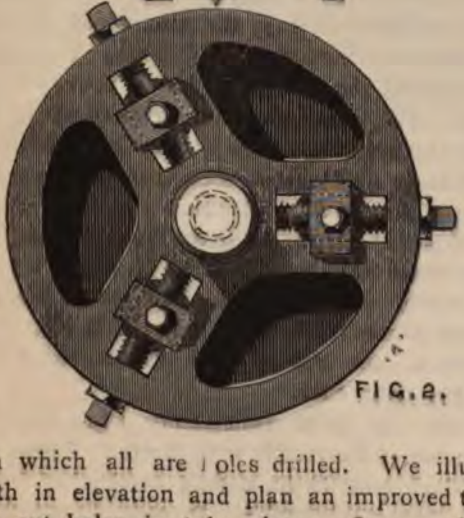


FIG. 2.

LAUNCHES AND TRIAL TRIPS.

[*We have to thank several correspondents for the valuable assistance they have rendered us by forwarding manuscript and newspaper accounts of launches, trial trips, etc. We wish to make this feature of the* MARINE ENGINEER *as complete and reliable as possible, and will thankfully receive all such information, or accounts of any novelties relating to any branch of the marine engineering trades. To ensure insertion, all such favours should be in our hands by the 23rd of the month.*—ED.]

LAUNCHES.—ENGLISH.

Barden Tower.—On the 29th January, a steamer of 3,500 tons burthen was launched by Messrs. Wigham, Richardson & Co., from their Neptune Shipyard, on the Tyne, for Messrs. Stumore, Weston & Co., of London and Liverpool. She is intended for the American trade, is specially fitted up for cattle, and has engines by the same builders of 1,300 effective horse-power; the boilers, three in number, comprising the very latest improvements for economy of fuel and for burning any kind of coal. She was christened by Miss Mary Down, from Edgebaston, the *Barden Tower*, the name of the seat of the Duke of Devonshire on the Wharfe. Immediately after the launch she was taken under the builders' 100-ton shear-legs to be masted and to have the machinery put on board. This is the third steamer built by Messrs. Richardson for Messrs. Stumore, Weston & Co., who have also lately added the Cunard liner, the *Algeria*, to their fleet.

Mauritius.—On January 29th, a powerful paddle tug steamer was launched from the works of Messrs. Laird Brothers at Birkenhead, by whom she has been built to the order of the Crown Agents for the Colonies, for service at the port of St. Louis, in the Mauritius. The new steamer was named the *Mauritius*, by Mrs. Thrupp, wife of Captain Thrupp, R.N., of H.M. ship *Resistance*, and is 130 ft. long, 25 ft. 10 in. broad, and 15 ft. 3 in. deep in hold, and will be fitted with two independent pairs of diagonal oscillating engines on the compound system, capable of exerting 900 indicated horse-power collectively, the cylinder being 28½ and 47 in. diameter respectively, with a length of stroke of 5 ft., and the working pressure 60 lbs. The general arrangement is very similar to the tug steamers, *Sampson* and *Malta*, built some little time since by Messrs. Laird for the British navy.

Walney.—The Whitehaven Shipbuilding Company launched a steamer named *Walney*, built for Captain Nelson, her dimensions being—length, 130 ft. ; breadth, 21 ft., depth of hold, 9ft. , and registered tonnage, 220 tons. She is fitted with a patent windlass by Emerson Walker & Co., and other modern improvements.

Lady Kate.—On February 1, a screw steamer was launched from the yard of Messrs. W. Thomas & Co., Millom, it being the first steamer that has been launched at that place. She has been built to carry 200 tons exclusive of coal, and is especially adapted for carrying iron ore, and for the Duddon trade. Her length is 98 ft, and her breadth 20 ft. ; depth of hold 10 ft. She was christened *Lady Kate*, and the ceremony was performed by Miss Massicks, eldest daughter of Mr. T. Massicks, The Oaks, Millom.

Ica.—On the 3rd February, there was launched by Messrs. Laird Bros., from there Birkenhead ironworks, an iron paddle-wheel steamer, for river service in Brazil, the second of three building by that firm for the Amazon Steam Navigation Company, Limited. The *Maua*, launched on December 23rd last, and the *Ica* are sister vessels in all respects, being 181 ft. long, 28 ft. beam, and 9 ft. 6 in. deep in hold, with a tonnage of 684 tons O.M., and they will be fitted with direct acting diagonal engines on the compound system to indicate 600-horse power. They will be fitted for a large number of passengers, having two tires of deckhouses, with wooden awning above, and various other special arrangements and appliances to adapt them for service in a tropical climate. The *Ica* was christened by Miss Alice Laird.

Romea.—On July 3rd there was launched from Earle's Shipbuilding and Engineering Company's yard, a very finely modelled steamer, which has been built to the order of Messrs. Thos. Wilson, Sons, & Co. The ceremony of launching and christening the steamer was gracefully performed by Miss Dossor, daughter of Captain Dossor, and the steamer was named the *Romea.* She will be under the command of Captain Dossor, who has had many years' experience in the Swedish Mail Service between Hull and Gothenburg. This steamer, which has been constructed for the mail and passenger service between Hull and Gothenburg, is of the following dimensions, viz. :—Length, 275 feet ; breadth, 34½ ft. ; depth, 20 ft. ; and her gross tonnage is 1800 tons. She has a long poop, somewhat similar to the *Rollo* and *Orlando*, and an extra long forecastle. For first-class passengers she has a very handsome and spacious saloon amidships (which when completed will be enriched with large oil paintings let into the panels), and sleeping accommodation for 40 persons, in state rooms, situated abaft the saloon, on each side of the ship, and fitted up with all modern appliances, &c., for the comfort of passengers, There is also a saloon and sleeping accommodation under the poop, aft, for 20 second-class passengers, and accommodation in the tween decks for over 1,000 emigrants. It is anticipated this ship will attain a speed of nearly 18 knots, and prove both a fast and comfortable boat. Her engines are of the direct-acting, compound, inverted cylinder type, with cylinders 38 in. and 76 in. diameter respectively, by 48 in. stroke, and are expected to indicate about 1,700 horse-power. They have steam starting gear and steam turning gear, and are fitted with all the latest improvements. The boilers, which are two double-ended ones, made of Siemens-Martin steel, are of very large size, so as to admit of the full power being kept up during the whole of the voyage. The vessel is also fitted with steam steering-gear amidships, and has Hasties' patent band gear aft. She has three pole masts, and will present a very smart appearance. It is expected this steamer will be a great improvement upon the present liners—the *Rollo* and *Orlando*—which, however, have been most regularly and satisfactorily worked by Messrs. Wilson between Hull and Gothenburg for the last ten or twelve years. After the launch the vessel was taken into Earle's Company's tidal dock, where the putting in of the masts and machinery was immediately commenced ; and it is expected she will be ready to sail early in March.

Inchulva.—On the 12th of February there was launched from the building-yard of Messrs. C. Mitchell & Co., on the Tyne, an iron screw-steamer, built to the order of Messrs. Hamilton, Frazer & Co., Liverpool. The vessel, which is named the *Inchulva*, is capable of carrying 3,300 tons deadweight, and although built to the highest class at Lloyd's has additional strength even beyond their requirements. She embraces all the most recent improvements for safe stowage and carrying of grain cargoes, and also for economical work, including steam steering gear. Her engines, which will indicate about 1,000-horse power, have been constructed by the Wallsend Slipway and Engineering Company (Limited), and possess all the most recent improvements for economy and efficiency.

Sarah Lizzie.—On the 14th February a wooden ship was launched at the Mushroom, a little below Newcastle, from the yard of Messrs. George Lindsay & Co. The extreme length of the vessel is 90 ft. and the length of her beam is 22 ft. ; the depth of her hold is 8 ft. 6 in. She is owned by Mr. John Slater, timber merchant, Newcastle, and is built specially to carry timber for the North-Eastern Railway Company. Her carrying capacity is 180 tons burthen, and she is classed 11 years A 1 at French Lloyd's. The vessel will be schooner-rigged. As the ship left the stocks Mrs. Lindsay, wife of the Builder, christened her the *Sarah Lizzie*, after the daughter of the Owner, Mr. Slater.

Regent.—On the 14th February, Messrs. Robert Thompson & Sons launched from their shipbuilding-yard at Southwick, Sunderland, an iron screw steamer, built to the order of Messrs. R. Conaway & Co., Liverpool, and registered under the Limited Liability Act, and is of about the following dimensions :—290 ft. long, by 37 ft. broad, and 28 ft. depth of hold, having been constructed on the spar deck rule, under Lloyd's special survey to class 100 A 1, and the Board of Trade for passenger certificate. Captain Douglas, of Annan, will command her. She has a large iron house aft fitted up for Captain and Officers, with accommodation for Engineers and petty Officers under bridge, and for Seamen and Firemen in lower forecastle. She is intended principally for the Southern States trade, and is being fitted throughout with all the latest improvments, including ample water ballast fore and aft ; for steam winches and donkey boiler by Messrs. Clarke, Chapman & Gurney, Gateshead ; crane on forecastle for lifting anchors, &c. ; Higginson's patent steam steering apparatus amidships, also patent screw gear aft ; Emerson & Walker's patent windlass, &c., &c. Her engines which are on the inverted direct acting compound surface condensing principle, and of 200-horse power, are by the North-Eastern Marine Engineering Company (Limited), Sunderland, and have been built under the personal superintendence of Messrs. Ashlin & Ashbridge, Liverpool. As the vessel left the ways she was christened the *Regent* by Miss S. E. Conaway, daughter of the Managing Owner.

Moggie.—On February 14th, Messrs. Edward Withy & Co., launched from Middleton Shipyard, West Hartlepool, an iron screw-steamer, built to the order of Messrs. Coverdale, Todd & Co., of West Hartlepool. Her principal dimensions are :—Length B.P., 235 ft. 6 in. ; beam extreme, 31 ft. 6 in. ; depth, moulded, 15 ft. 8½ inches. She is built to Lloyd's highest class, and has long quarter deck, bridge-house, and topgallant forecastle, double bottom all fore and aft on the cellular principle ; iron decks, iron chart-house, iron engine and cabin skylights, and iron cabin companion. She will be fitted with engines of 100-horse by Messrs. T. Richardson & Sons, of Hartlepool, ironworks. This vessel is No. 94 in the builders' yard, and the fourth built by the same Owners. As the steamer left the ways she was christened *Moggie*, by Miss Belk.

Florence.—On the 15th February Messrs. Craggs & Son, launched a vessel from their yard at Middlesbrough. She is an iron screw steamer, measuring 125 ft. long, 21 ft. 6 in. broad, and 8 ft. 9 in. deep, and is to carry 250 tons. As the ship left the slipway she was christened the *Florence* by Miss Appleton, daughter of the principal owner. Her engines will be 35 horse-power nominal, and supplied by Messrs. Blair, Stockton. The vessel is intended for the coasting wheat trade.

Cascapedia.—On February 16th there was launched from the yard of the Sunderland Shipbuilding Company (Limited) a screw steamer, built to the order of Messrs. Crow, Bogart, & Rudolf, of Liverpool, the leading dimensions, &c , of which are as follows :—Length, 325 ft. ; breadth, 40 ft, ; depth, 31 ft. ; gross tonnage, about 3,000, and has been built to the spar deck grade, taking the highest class at Lloyd's under special survey, and is intended for the tea trade. The vessel is rigged as a two-masted schooner, the lower masts being of iron ; she is fitted with a patent windlass, by Emerson, Walker, & Co., has powerful steam winches, steam steering gear, &c., and is replete in every modern improvement. The saloon contains accommodation for the Captain, as well as a number of spare berths for passengers, the whole of the officers being berthed in the deck-houses amidships. The engines, which are very powerful, are by the North-Eastern Marine Engineering Company, and are of the latest and best type, having all modern improvements for economical and efficient working. On leaving the ways the ceremony of naming her the *Cascapedia* was performed by Miss Crow, daughter of one of the owners.

Panama.—On February 16th, Messrs. Osbourne, Graham, & Co., launched from their yard at Hylton an iron screw steamer, to class 100 A 1 at Lloyd's, for Messrs. A. d'Orbigny & Fanstin Fils, of La Rochelle, intended for the Atlantic trade, and of the following dimensions and particulars:—Length, 280 ft.; breadth, 36 ft.; and 24 ft. 6 in. depth of hold; built on the three-decked grade, with iron decks laid; long bridge house, containing accommodation for captain, officers, and a few passengers; topgallant forecastle, and iron hood aft protecting steering gear. The vessel will be fitted with four steam winches, steam steering and reversing gear, Harfield's patent windlass, and in every way suitable for the above trade. Engines of 180 horse-power will be fitted on board by Messrs. Hawks, Crawshay, & Sons, of Gateshead. On leaving the ways she was named the *Panama* by Mrs. James Davison, of St. Ives, Hants.

Mytilene.—On the 17th February there was launched from the yard of Messrs. Short Brothers, at Pallion, Sunderland, a screw steamer of the following dimensions, &c., built to the order of Messrs. Lumsdon, Byers, & Co., of Sunderland:—Length, 265 ft.; breadth, 36 ft.; depth of hold, 22 ft., having a deadweight carrying capacity of about 2,600 tons. The vessel is built to the highest class at Lloyd's under special survey, on the cellular bottom principle, and is fitted with full poop to accommodate captain officers, &c.; bridge house over engines and boilers amidships, with spacious accommodation for engineers; and topgallant forecastle for crew. She is fitted with all the latest improvements for quick loading and discharging, the holds being divided into watertight compartments, with a large hatchway and steam winch at each. She also carries Emerson, Walker, & Co's Patent Brass Cone Brake Combination Windlass. On leaving the ways, the vessel was named the *Mytilene* by Miss Winifred Byers. The vessel was taken to Mr. George Clark's works at Southwick, by whom she is to be fitted with engines of 180 horse-power, with all the latest improvements.

Lady Katherine.—On February 19th there was launched from the Wear Dockyard, Sunderland, by Messrs. S. P. Austin & Son, an iron screw steamer of the following dimensions: — Length between perpendiculars, 210 ft.; breadth (extreme), 30 ft.; depth of hold, 16 ft. 8 in.; with long raised quarter-deck and topgallant forecastle; 935 tons gross; to class 18 years red Liverpool registry. Compound surface condensing engines and boiler will be fitted by the North-Eastern Marine Engineering Company, Sunderland. She is fitted with a patent windlass, two steam winches, donkey boiler, double bottom for water ballast, steam steering gear, by J. N. Holliday, and all the latest improvements. She has been built to the order of the Right Hon. the Earl of Durham. As she left the ways she was named the *Lady Katherine* by Miss Sybil M. Austin.

Jane Kelsall.—On the 31st January a steamer of 2,500 tons was launched from Messrs. John Readhead & Co.'s yard, South Shields, to the order of Mr. Wm. D. C. Balls, Tynemouth. She is built specially for the Atlantic and Indian trades, with the latest improvements. She has two decks, and is built to take the highest class at Lloyd's, and will be engined by the builders. As the steamer left the ways she was christened the *Jane Kelsall*, by Mrs. Kelsall, of Waterloo, Liverpool, sister of the managing owner. This is the third steamer that Messrs. John Readhead & Co. have built for Messrs. W. D. C. Balls and partners.

Maria Hartmann.—On the 31st January a screw-steamer named the *Maria Hartmann*, and built for Messrs. Ward and Holzapfel, of Newcastle, was launched from the iron shipbuilding yard of Messrs. Schlesinger, Davis & Co., at Wallsend. The principal dimensions of this vessel are; Length between perpendiculars, 260 ft.; breadth moulded, 36 ft.; and depth of hold, 20 ft. 4½ in. She has been built under the inspection of the Liverpool surveyors and the owners' surveyors, and will obtain the highest class in the Underwriters' Registry. The general arrangements of the vessel are; an open topgallant forecastle, large bridge which covers and protects the engine and boiler rooms, and also covers the officers' and engineers' cabins; iron chart house; steam windlass of Harfields patent; powerful steam winches; steam steering gear, and every convenience for the speedy and efficient working of the vessel. The cabins are aft under a half poop. The engines have been constructed by Messrs. Thos. Clarke & Co., of Newcastle, and are of 150 nominal horse-power, with cylinders 31 in. and 60 in. diameter, with a stroke to each of 49 in. boilers capable of bearing an ordinary working pressure of 80 lbs. per square in. are ready for putting on board, and the whole of the machinery and boilers have been built under the superintendence or Mr. Sheriff, the owners' superintending engineer. The christening ceremony was performed by Mrs. G. W. Ward.

LAUNCHES.—SCOTCH.

Penang.—On January 27th there was launched from the shipbuilding-yard of Messrs. Ramage & Ferguson, Leith, an iron screw steamer, specially designed for the Far East. She has been built to the order of Messrs. John Warrack & Co., Leith, for Chinese owners in Singapore, and besides having capacity in her hold for stowing about 11,000 piculs of rice, a continuous shade-deck affords shelter for a large number of native deck passengers, while in the poop and deck-houses first-class passengers and the European officers have ample accommodation. The vessel is fitted with steam winches, Emerson, Walker & Co.'s patent horizontal direct steam windlass and capstan, steam apparatus for cooking rice for the passengers, and every appliance that could increase her efficiency has been introduced. On leaving the ways she was named the *Penang* by Miss Warrack, of Edinburgh. Her engines of 110 horse-power nominal will be supplied by Messrs. T. Richardson & Sons, West Hartlepool.

Puno.—On January 27th, Messrs. R. Napier & Sons launched from their shipbuilding-yard at Govan, a steel screw-steamer for the Pacific Steam Navigation Company, Liverpool. This is the first of two steel steamships of 2,500 tons which Messrs. Napier are building for this company. She was named the *Puno.*

Glenarm.—On the 28th January, Messrs. H. M'Intyre & Co. launched at Paisley the *Glenarm*, a steel screw steamer of 303 tons B.M. The *Glenarm*, which is the property of the Eglinton Chemical Company (Limited), Glasgow, will be fitted with a pair of compound surface-condensing engines of 60-horse power by Messrs. R. H. Pearson & Co., Glasgow. This is the second steamer built by Messrs. H. M'Intyre & Co. for the same owners, and forms the third of their fleet which is entirely occupied in carrying limestone from their quarries and harbours at Glenarm and Ballintoy, in the north of Ireland.

Ely.—On January 29th, a new hopper dredger named *Ely*, built and engined by Messrs. W. Simons & Co., was launched complete from their works at Renfrew. It is the property of the Taff Valé Railway Company, and is to dredge to 30 ft. depth, and cut its own flotation in shoals. It carries its own dredgings, and also loads side barges, and tows them when required. This is the ninth hopper dredger this firm have constructed, and they have another in progress to carry 1,400 tons of its own spoil. It is to steam to New Zealand, and will be the largest dredger in the world.

Catherine Auld.—On the 1st February there was launched from Messrs. R. D. Ross's Patent Slip Yard, Inverkeithing, a brigantine of 320 tons burthen, and classed A at Lloyd's 11 years. On leaving the ways she was named the *Catherine Auld* by Miss Ross. The vessel is intended for the Brazil trade, and will be commanded by Captain John Ross, if not disposed of before being completed.

Compta.—On the 2nd February there was launched from Messrs. A. & J. Inglis' shipyard, Pointhouse, an iron screw steamer of 2,100 tons, for the East Indian trade. This vessel, which has been named the *Compta*, is to the order of Messrs. Gray, Dawes, & Co., London, and is a sister vessel to the *Camorta*.

Imperial.—On the 10th February, at Port Glasgow, there was launched from the shipbuilding-yard of Messrs. John Reid & Co., an iron steamer named the Imperial, of 600 tons, built to the order of Thomas Dewsbury, Esq., of Leeds. Her engines of 110-horse power, will be furnished by Messrs. Kincaid, Donald & Co., Greenock. This vessel has been specially constructed for trading purposes on the West Coast of South America, and has been furnished with all the latest improvements to ensure speed and combine large carrying capacities on a light draught of water.

Valdivia.—On February 10th, Messrs. John Reid & Co. launched from their yard at Port Glasgow, an iron screw steamer of the following dimensions:—Length 170 ft., breadth of beam, 27 ft., 6 in., depth of hold, 13 ft., of 600 tons builders' measurement. The new steamer, which is named the *Valdivia*, is a vessel of light draught, and is fitted with a steam windlass and all modern improvements and facilities. The engines, of 110-hoise power, will be supplied by Messrs. Kincaid, Donald & Co., Greenock. The *Valdivia*, has been built to the order and under the personal superintendence of Mr. Thomas Dewsbury, Springfield-place, Leeds, and is intended to trade on the West Coast of South America.

Glen Gelder.—On the 12th February there was launched from the building-yard of Messrs. Alexander Hall & Co., Aberdeen, an iron screw steamer, of the following dimensions:—Length, 195 ft. breadth, 31 ft., depth of hold, 13ft. 6 in., gross register, 770 tons. The vessel has been built under special survey and classed in the highest class 100 A1 at Lloyd's. She will be fitted with water ballast-steam winches, patent windlass, and other improvements. She has been built to the order of Messrs. Connon & Fleming, and will be engaged chiefly in the Baltic trade, and is to be commanded by Captain Esson. As she left the ways she was christened the *Glen Gelder* by Miss Eliza Reid, daughter of Provost Reid, of Arbroath. The vessel was then taken to the shear-poles, where engines of 100-horse power nominal will be fitted up by Messrs. Hall, Russel & Co.

Strathallan.—On the 12th February, the *Strathallan* iron screw steamer, built in Kingston-yard, Port Glasgow (Messrs. H. Murray & Co.), was launched. She is the second vessel by Messrs Henry Murray & Co., and engined by William Kemp, Esq., of Govan, for Messrs. James Hay & Sons, Glasgow, and is somewhat larger than her predecessor, the *Strathyre*, now almost ready for sea, and which was launched on the 13th January, the *Strathallan's* dimensions being:—Length 180 ft., breadth, 27 ft. 6 in., depth 14 ft., while her engines, which are of the compound surface-condensing type, are of 98-horse power. Captain George Dean, formerly of the *Pearl* (s), belonging to the same firm, will command the *Strathallan*.

Missouri.—On February 15th, Messrs. Charles Connell & Co. launched from their shipbuilding-yard at Scotstoun an iron full-powered screw-steamer, built to the highest class both in English and French Lloyd's and to Board of Trade requirements, for Messrs. George Warren & Co., Liverpool. She has been built with special reference to the Company's service between Liverpool and Boston, and she is to be commanded by Capt. A. H. Burwell, the senior Commander of the Warren Line. Her dimensions are:—Length, 425 ft.; breadth, 43 ft. 6 in.; depth, 35 ft. 6 in.; and tonnage under deck, 5,100 tons. As she left the ways, Miss Connell, daughter of Mr. Chas. Connell, the builder, named her the *Missouri*. The steamer will receive machinery from the works of Messrs. John & James Thompson, Finnieston Engine Works. The engines are on the compound principle of 3,000 horse-power, high-pressure cylinder being 50 in., low-pressure 94 in., stroke 5 ft., and supplied with steam from four steel boilers at working pressure of 80 lbs. to the square inch. The steamer is fitted with four decks, three of which are of iron throughout the entire length, and sheathed with wood planking. She is divided into eight water-tight compartments, and has water-ballast capacity to the extent of 700 tons, and her dead-weight cargo and coal capacity will be 5,500 tons. She will be fitted with the latest and most improved methods for the carriage of cattle and cargo, permanent and very strong grain bulkheads being fitted to comply, in every particular, with the late Act with reference to grain cargoes.

Ordonez.—On the 15th February there was launched from the shipbuilding-yard of Messrs. Campbell & Co., Abbotsinch, Paisley, a screw steamer for the Spanish Royal Mail service. On leaving the ways the vessel was named *Ordonez* by Miss Semple, daughter of one of the partners of Messrs. Campbell & Co. The *Ordonez* is built to the order of the Marquis de Compo, Manila. Messrs. Hutson & Corbett, Kelvinhaugh-street, Glasgow, are the makers of the engines.

Orontes.—On the 15th February an iron sailing ship named the *Orontes* was launched from the shipbuilding-yard of Messrs. Walter Hood & Co., Aberdeen. The *Orontes* was built to the order of Messrs. George Thompson & Co., and is intended to form one of their Australian fleet. Her register tonnage is 1,382.

James Watt.—On the 15th February there was launched from the shipbuilding-yard of Messrs. Robt. Duncan & Co., Port Glasgow, an iron screw steamer, named the *James Watt*, built to the order of Messrs. Leitch & Muir, Greenock. The following are her dimensions:—260 by 36 by 24, and about 1,700. This vessel will be furnished with all the latest improvements, and supplied with compound engines of 160 horse-power by Messrs. Rankin & Blackmore, of Greenock.

Mount Lebanon.—On February 16th, Messrs. Alex. Stephen & Sons, launched from their yard at Linthouse, a screw steamer of about 2,500 tons, and classed 100 A 1 at Lloyd's, under special survey. This vessel has been built to the order of Mr. John Smith, Glasgow, and is fitted with all the most approved appliances for loading and discharging cargo. She has excellent accommodation for a limited number of first-class passengers, and is constructed with provision for water-ballast, on the bracket principle, in a double bottom throughout. Her engines, which were fitted on board before launching, are of 240 horse-power nominal, having cylinders 38 and 68 in. diameter, by 45 in. stroke, with boilers of ample capacity, suitable for 85 lbs. pressure, and are of the most improved modern type. The vessel was named the *Mount Lebanon*, by Mrs. Black, the wife of Captain Black, who is to take command of the vessel.

Beryl.—On the 16th February a steamer, built by Mr. W. B. Thompson, to the order of Mr. P. M. Duncan, was launched from the Caledon shipyard, Dundee. The vessel, which was christened the *Beryl* by Mrs. P. M. Duncan, is 235 ft. in length, 32 ft. in breadth, and 16¼ ft. deep in the hold; her gross tonnage is 1,150 tons, and her engines are to be 130-horse power. All the most improved appliances are to be fitted on board the steamer, including Fox's patent corrugated boiler furnaces, by which a considerable saving of fuel is expected to be effected, and Higginson's steam-steering gear. The *Beryl*, which is to be employed principally in the Mediterranean and Baltic trades, is to be commanded by Captain David Douglas, formerly of the *Amethyst*.

Glenavon.—On the 16th February, the London & Glasgow Shipbuilding Company launched from their yard at Govan the latest addition to the Glen Line of steamers plying between London and China, managed in London by Messrs. M'Gregor, Gow & Co. The new steamer, which was named the *Glenavon* by Miss Jenny Kinghorn, is 360 ft. long, 43 ft. broad, and 26 ft. deep, with a gross tonnage of about 3,000 tons, and will be fitted by her builders with compound surface condensing engines of 530-horse power, of the most approved construction. The *Glenavon* is a sister ship to the *Glenfruin*, completed last month by the London & Glasgow Shipbuilding Company for the same Owners.

Drummond Castle.—On the 17th February Messrs. John Elder & Co., launched from there building-yard at Govan another iron screw steamer, of 3,700 tons gross register, for Messrs. Donald Currie's Castle Line of South African mail packets. This steamer, which was named the *Drummond Castle*, is of the same dimensions and identical in arrangement to the *Garth Castle* launched by the same builders in December last, her length being 376 ft.; breadth, 43 ft. 6 in.; depth, 32 ft. 9 in. The *Drummond Castle* is classed in the highest grade at Lloyd's as a three-decked vessel, with extra iron decks, double sheer strake, and several other extras above Lloyd's scantlings. The vessel is to be brig-rigged, with lower-masts and yards of steel. She has accommodation for 166 first-class, 84 second class, and 126 steerage passengers. Accommodation has also been provided for her officers and crew, who will number about 100 persons. The vessel is fitted with steam steering gear, the steering wheels being placed on upper bridge or promenade deck, while additional steering gear is provided at the stern, with a view to greater safety. She is also fitted with windlass, four horizontal steam winches, and all the latest improvements. The engines, which will be supplied by the builders, are compound, with inverted cylinders, the high pressure 51 in. and the low pressure 88 in., by 4 ft. 9 in. stroke, steam to be supplied at 75 lbs. pressure from two cylindrical boilers, and the engines will indicate about 3,200-horse power. In a special manner the *Drummond Castle* is fitted like other ships of the fleet, for war purposes, the three decks being of iron, and sufficiently strong to carry guns of heavy calibre, and the watertight compartments, of which there are nine, will be of service in the event of the vessel being fired into and damaged below the water line. The diversion of the watertight compartments are carried up to the upper deck, and in four of the bulwarks there are watertight and fireproof doors. By this arrangement there is no danger in the event of fire breaking out in any division of the ship, and the special care in providing for the safety of the lives on board entitles the vessel to be entered on the Admiralty list as a first-class transport.

Ocean Rover.—On the 17th February, there was launched from the shipbuilding-yard of Messrs. D. Allan & Co., Leith, a screw steamer of 70 tons gross register, named the *Ocean Rover*, built to the order of Messrs. Wm. Gunn & Co., Granton. Her dimensions are:—Length, 90 ft.; breadth, 16 ft. 6 in.; depth, 8 ft. 6 in. She is intended for fishing and trawling purposes. Her engines will be supplied by Messrs. Muir & Houston, Glasgow.

TRIAL TRIPS.

Elfrida.—On the 27th January the screw steamer *Elfrida* proceeded down the Clyde on her trial trip. The result proved highly satisfactory to all concerned. Under easy steam she attained a speed of fully 10 knots over the measured mile. This vessel has been built by Messrs. Campbell & Co., of the Abbotsinch Shipyard, Paisley, to the order of Messrs. A. C. Colvil & Co., of Glasgow. The *Elfrida* being the first vessel launched by her builders, the trial-trip was looked forward to with some interest. Her dimensions are—165 ft. long, 24 ft. 6 in. broad, by 13 ft. depth of hold. She has been specially designed as a fruit and ore carrier, being of full model, with large carrying capacity. She is fitted with water ballast fore and aft, and all the latest improvements for 100 A 1 class cargo steamer. Her machinery, consisting of a pair of compound surface-condensing engines of 70 nominal horse-power, has been supplied by Messrs. Fleming & Ferguson, of the Phœnix Works, Paisley.

Lee.—On the 8th February the new screw steamer *Lee*, recently constructed by Messrs. W. Simons & Co., Renfrew, proceeded on its trial trip, with the owners and the directors of the City of Cork Steam Packet Company, when a very satisfactory result was subsided. A speed of 13 knots was realized, and the ship and engines were severely tested in steaming against the gale and snowstorms which prevailed. The dimensions of the *Lee* are 270 by 36 by 20½. It is 1,200 tons gross register, and 1,600 tons builders' measurement; and has the highest class at Lloyd's and Board of Trade. It is fitted with compound engines, and two steel boilers working at 80 lbs. pressure; the diameter of cylinders is 73 and 40 inches, and length of stroke 45 inches. It is fitted with Harrison's steam steering gear, and steam appliances for mooring, loading, and discharging.

Mandarin.—The screw steamer *Mandarin*, 850 tons, built by H. M'Intyre & Co., Paisley, and engined by Hutson & Corbett, Glasgow, ran her trial trip on the 9th of February, between the Cloch and Cumbrae Lights, heavily loaded with 800 tons of coal, and realized the speed of fully nine and a half knots, considerably in excess of that guaranteed by her builders and engineers, thus giving the utmost satisfaction to her Owners. After the trial the *Mandarin* returned to the Gareloch for compass adjusting.

St. Pauli.—On the 12th February the latest addition to the fleet of vessels in which Mr. J. H. Lorentzen, of Hamburg, is interested, took its first trip to sea. The *St. Pauli* was built at Pallion by Messrs. Short Brothers, under special survey for the highest class, according to Liverpool rules, and was launched in December last. Her dimensions are as follows:—Length between perpendiculars, 220 ft.; breadth, 37 ft.; depth of hold, 17 ft. 9 in.; and deadweight carrying capacity, 2,150 tons. Water ballast can be carried both fore and aft. There are four of Price's large self-trimming hatchways, with a powerful steam winch at each, and a new patent donkey boiler and engine at the bridge-house, by which the process of loading or discharging will be easily and rapidly effected. The vessel is also fitted with a patent hand and steam power windlass by Hatfield, and steam steering gear by Holliday, of Sunderland. Her engines are of 160 horse-power, and were built by Mr. John Dickenson, of the Palmer's Hill Engine Works, Monkwearmouth. The *St. Pauli* is the latest example of the principle advocated by Messrs. Short, a greater proportion of breadth to depth than is usually allowed by builders. The weather, though not of a nature as to allow of a regular trial for speed, afforded a test of the seagoing qualities of the *St. Pauli* in the run between the Wear and the Tyne, such as could not be obtained on an ordinary day. There was a strong sea running, and the way the vessel behaved gave entire satisfaction to all concerned. The engines worked smoothly and well, an average speed of 11 knots an hour being noted.

Gainsborough.—The steamship *Gainsborough*, recently launched by Earle's Shipbuilding and Engineering Company (Limited), was taken on her trial trip. She has been built for the Manchester, Sheffield, & Lincolnshire Railway Company's passenger trade between Grimsby and Hamburg. Her dimensions are:—Length, 231 ft.; breadth, 30 ft. 2½ in.; depth of hold, 17 ft.; and her gross measurement is 1,081 tons. She is rigged as a three-masted schooner, having pole masts. The vessel has on deck a large number of cattle pens, and also has accommodation for cattle under the poop deck amidships. Her engines are of the compound direct-acting, inverted cylinder type, and 150 nominal horse-power, having cylinders 32 in. and 62 in. diameter by 36 in. stroke; and on the trial trip they worked most satisfactorily, running full speed the whole of the time without a hitch of any kind; the speed, as taken from Spurn to the Bull Float, was found to be nearly 12 knots, which is very satisfactory to both the builders and the owners. The engines were stopped and altered from hard a-head to full speed astern in 23 seconds.

Garth Castle.—The trial trip of the steamship *Garth Castle*, of Messrs. Donald, Currie & Co.'s Cape Mail Line, took place on February 18th. The *Garth Castle* is an iron steamer of 3700 tons gross register, her dimensions being 376 ft. in length, 43 ft. 6 in. beam, and 32 ft. 8 in. in depth, brig rigged, and has accommodation for 166 first-class, 80 second-class, and 130 third-class passengers, all fitted up in the best style, and with every attention to the ventilation of the apartments, and the health and comfort of those on board. The steamer is fitted with all the latest improvements for loading and unloading, has steam steering gear amidships and a steam windlass. The engines of the *Garth Castle* have been constructed by the builders of her hull. They consist of a high-pressure cylinder of 51 in. diameter, and a low pressure cylinder of 88 in. diameter, with a stroke of 4 ft. 9 in. On trial these engines gave most satisfactory results, having developed 3,325 indicated horsepower, steam pressure 75 lb., vacuum, 28, revolutions, 66, the average speed being 14·32 knots. Several novelties have been introduced in the construction of the machinery, not usually met with in merchant steamers. The boilers have Fox's corrugated steel flues, the funnel has a double casing to lessen the decrease of the temperature of the ascending gaseous column, and so to promote draft. The starting and reversing gear is on Brown Bros.' patent, and control the engines so easily that the most delicate young lady can operate on them. Her powerful centrifugal pumps, made by J. & H. Gwynne, of Hammersmith, can pump out either the bilges or the water-ballast, or can circulate water through the condenser in the event of any injury occurring to the ordinary pumps. The propeller shaft is of Whitworth's fluid compressed steel, 60 per cent. stronger than a shaft of same diameter made of ordinary iron. A special feature is the adoption, in this vessel, for the first time in a merchant steamer, of Manganese bronze propellor blades. The great strength of this material, which contains 78 per cent. of copper, and its perfect immunity from corrosion and pitting, render it possible to make the blades very materially thinner than those of any other metal, whilst at the same time a thoroughly smooth surface is obtained, and a perfectly true pitch, the blades not being liable to be distorted as in the case of steel blades when being annealed. These advantages are clearly illustrated by comparing the performance of the *Garth Castle* with that of her predecessor, the *Kinfauns Castle* built by the same firm. These vessels have precisely similar engines and boiler pressure, the *Kinfauns Castle* has steel propellor blades 24¼ ft. pitch and 19 ft. diameter; she made 63 revolutions and 13·9 knots on trial, while the *Garth Castle*, with Manganese bronze propellor blades 25 ft. pitch and the same diameter, acomplished 66 revolutions, and 14·32 knots on trial. There can be no doubt that the sagacious example of Mr. Currie will be followed by the Great Mail Steamship Companies, and probably also by private owners; indeed, the builders of the *Garth Castle* have on hand orders to fit Manganese bronze propellor blades on twelve large steamers they are now building, and several other prominent engineers are adopting the same system.

Furnessia.—Great advances have recently been made in the important industry of iron shipbuilding, and alike in dimensions and equipment the vessels of the present day differ very materially from those which were constructed only a few years ago. No doubt the improvements effected by naval architects recommend themselves to shipowners, but there can be doubt that the healthy spirit of rivalry which prevails amongst the great ocean carrying companies of the world has been a powerful factor in determining the character of ship construction. On the great Atlantic highway the race for first position with swift and efficient vessels has been very keen, and seems to be getting keener every day. Thus the Cunard, the Guion, and Allan Lines have each added to their fleets unusually large ships, while the Cunard and the Inman Lines are having constructed at present vessels which in point of tonnage will rank next to the Great Eastern. Shipowners have been manifesting a growing confidence in length of keel, and the scruples which at one time existed against entrusting too much to one bottom seem to have entirely disappeared. In order not to be outstripped by rivals, Messrs. Henderson Brothers have just added to their fleet the *Furnessia*, a vessel which, for size and equipment, will bear favourable comparison with anything afloat. The new Anchor Liner was berthed at Finnieston Quay, and a select party had an opportunity of inspecting the ship. The *Furnessia* was built at Barrow-in-Furness, by the Barrow shipbuilding Company. The principal dimensions of the new vessel are:—Length 445 feet; breadth, 44 ft. 8 in.; depth, 34 ft. 6 in.; gross tonnage, 5,495 tons; register tonnage, 3,613 tons. It has accommodation for 250 saloon and 1,300 second-class and steerage passengers. The vessel is propelled by two direct-acting compound surface condensing engines of 600 horse-power nominal, the diameter of the cylinders being 49 in. and 100 in. respectively, and the length of stroke 5 ft. 6 in. There are four double-ended boilers, each having six furnaces, or 24 in all. The vessel is fitted with Emerson, Walker & Co.'s patent horizontal direct steam Winlass, especially designed for working $2\frac{3}{16}$ in. cables and two powerful warping capstains on forecastle deck, also patent brass cone cable controllers by same makers. The performance of this windlass at the trial was highly eulogised by all present, and it was considered to be a fine specimen of modern engineering. She also carries Muir & Caldwell's steam stearing gear, specially designed for this ship, and it can be steered from three different places—namely, aft, amidship, and from the bridge; so that in almost any emergency that may arise complete control can be exercised over the movements of the monster vessel. On the promenade, spar, and main decks everything has been done that experience and the resources of naval architecture could do to utilize space and administer to the comfort and convenience of the passengers. The promenade deck is of unusually large dimensions, and as the vessel is worked from the main deck the passengers have ample room for exercise and recreation. From the smoking-room, which is on the promenade deck, entrance is obtained by a balcony to the music or drawing room, both of which have been designed on exceedingly beautiful lines. In the drawing room are a piano, an American organ, and a library. The ventilation of this room is very satisfactory, the sky lights at the top being so arranged that they may be left open in every description of weather. On each side of the drawing-rooms are rows of state-rooms, and these have been furnished in a very luxurious style. Adjoining the drawing-room is the ladies' cabin, an elegant resort, in the beautiful furnishing of which blue velvet and silk hangings have been used with fine effect. On each side of the spar deck are rows of state cabins, a new arrangement, which will ensure thorough ventilation. The main deck contains the chief saloon, but otherwise it is exactly the same as the spar deck. The chief saloon is a veritable work of art, and will bear comparison with any palace afloat. The roof is white and gold, the pillars are of polished oak, and the panellings are outside the beaten track of ship furnishing, being made of a rare wood which the builders had difficulty in procuring. No less than 150 persons can be seated in the saloon, which, owing to its great breadth, admits of free access to all the tables. Off the main saloon is the steward's pantry, and the arrangements in this department of the ship are very complete. The wine cellar, which is of easy access from the pantry, is capable of storing a thousand dozen bottles. The whole of the lower cabins can be removed during winter, and the space thus obtained made available for cargo. In the part of the vessel devoted to steerage passengers the arrangements are excellent, there being numerous lavatories with abundant supplies of fresh and salt water. In all parts of the vessel pneumatic bells are fitted, so that passengers can readily put themselves in communication with the steward. The vessel is fitted with Sir William Thomson's compasses and sounding machines, and also numerous appliances in the department of ship equipment for working the vessel to the best advantage. A special feature of the vessel is its ventilation, which is everywhere perfect. Even in the regions of the engines and boilers there are currents of fresh air. The vessel is equipped with 10 boats, and these are worked by means of a steam lowering apparatus invented by Captain Meiklereid, the marine superintendent of the Anchor Line. Captain John Johnston Small, late of the Anchor Liner *Bolivia*, takes command of the new ship, which will be manned by by a crew of over a hundred men. The new *Furnessia* sailed from Glasgow for New York on February 17th on her maiden trip. The *Furnessia* was launched at the end of October last.

Seahorse.—The new and powerful twin screw ocean tug *Seahorse*, Commander Parker, which was built and designed by Messrs. Laird, of Birkenhead, has been officially tested for speed, at various conditions of power, on the measured mile in Stokes Bay. Capt. Dowding took command of the ship on the occasion, while the machinery was superintended by Mr. Charles Icely, of the Portsmouth Steam Reserve. The day was somewhat boisterous, the wind blowing with the force of from 5 to 6 ahead and astern of the ship while running up and down the mile. The trim was slightly different from that of the *Seahorse* when she made her contractors' six hours' trial a few months ago, her draught being 8 ft. 9 in. forward and 12 ft. 8 in. aft, instead of 9 ft. 9 in. and 11 ft. 11 in. The engines were tested under the three conditions of full power, two-thirds power. and one-third power. Both as regards the total mean of the horse-power indicated and the speed realized the results were even more satisfactory than at the six hours run, when the *data* obtained were 1,165·02 horses and a speed of 12·6 knots per hour under full power. The engines were stopped in seven seconds, started astern in three seconds, and reversed and started ahead in seven seconds. Being a new vessel, the *Seahorse* was tested as to her turning power under full and half power, with one engine going ahead and one astern, and also with one engine only. The results were deemed satisfactory, but the figures under the condition of full power will suffice. Circling to starboard, the half circle was completed in 2 minutes 30 seconds, and the full circle in 5 minutes 5 seconds, the diameter being 488 yards. Circling to port, the half circle was completed in 2 minutes 37 seconds, and the full circle in 5 minutes 10 seconds, the diameter being 515 yards. The angle of the rudder was 30 degrees, the time occupied in putting the helm over 30 seconds, the number of turns of the wheel 4¼, and the number of men at the wheel two. The steam winch for raising the anchor was also tried, and the ship was declared ready for active service.

Fylde.—Some time ago the Harbour Trustees at Fleetwood opened a fine new dock of about 20 acres in extent, and with the view of developing the natural advantages possessed by the locality it was resolved to place a tug steamer on the river of sufficient power to cope with a large ship of about 1,000 tons register struggling against a seven knot tide. The building of the steamer was entrusted to Mr. Marsden (the brother of Sir James Marsden, of Barrow), who contracted with Messrs. John Reid & Co., Port-Glasgow, for the hull, and Messrs. Rankin & Blackmore, engineers, Greenock, for the machinery. The external arrangements of the steamer are remarkably perfect, but as the engine power is the more important part of the vessel, it is satisfactory to state that the Messrs Rankin & Blackmore have furnished a pair of their patent engines—(duplicate of the successful steamer *Allowrie*, just arrived at Melbourne), of improved excellence. The *Fylde* is a steamer of the following diamensions :—Length, 122 ft. ; breadth, 22 ft. ; and depth of hold, 12 ft. Her engine power consists of Mr. Rankin's patent of high and low pressure engines of 98 h.p. nominal, indicating about 500 horse-power. On the measured mile yesterday a speed of about 11 knots was attained, which was recognized as being most satisfactory. The steamer is provided with water ballast tanks, and her internal accommodation is of the most complete discription.

Correspondence.

[*It must be understood that in giving insertion to communications under this heading, we do not in any way pledge ourselves to the opinions preferred therein. We will with pleasure insert any letters ikely to benefit our readers, either from their intrinsic value, or as being calculated to promote such discussion as will elicit facts, valuable from their being the result of practical experience.*—ED.]

To the Editor of the MARINE ENGINEER.

DEAR SIR,—If you will kindly insert the following question for solution in your valuable paper I should feel greatly obliged. The question, though not, perhaps, very valuable in a practical point of view, may be so on account of the principle involved, and will greatly help the student in realizing the subject. I have myself, by the aid of the differential calculus, solved the problem, but I should like to see it treated by algebra alone.

The article by Professor Marks in the February number of the MARINE ENGINEER, headed " What is the most economical point of cut-off for steam engines ? " is, without doubt, a most valuable piece of information, and will be greatly appreciated by a large circle of readers, on account of the practical and lucid way in which the subject is treated.

I am, Sir,
Yours truly,

Chatham, *February 5th*, 1881. L. J.

The amount of fuel consumed by a steamer varies as the cube of the velocity. She consumes 1·5 tons of coal per hour at 18s. per ton, when her speed is 15 miles per hour. She costs, for other expenses, 16s. per hour. Find the least cost for a voyage of 2,000 miles.

Let x be the speed for which the best result is obtained.

Then $\frac{2000}{x}$ is the time occupied in travelling 2,000 miles,

$$\therefore \text{cost of working the ship} = \frac{2000}{x} \times 16 = \frac{32000}{x} \quad \ldots \quad (1)$$

Again :—Since the amount of fuel varies as the cube of the velocity, the amount of fuel consumed at a speed x miles per hour = $\frac{x^3}{15^3} \times 1{\cdot}5$ tons per hour.

$$\therefore \text{in } \frac{2000}{x} \text{ hours the consumption} = \frac{x^3 \times 1{\cdot}5}{15^3} \times \frac{2000}{x}$$

$$\therefore \text{cost of fuel} = \frac{x^3 \times 1{\cdot}5 \times 2000}{15^3 \times x} \times 18 = 16\,x^2 \ldots \quad \ldots \quad (2)$$

Adding (1) and (2) and letting c be the total cost, we have

$$c = \frac{32000}{x} + 16\,a^2 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (3)$$

$$\text{Differtiating } \frac{d\,c}{d\,x} = \frac{32000}{x^2} + {}'32\,x = 0 \quad \therefore x = 10 \quad \ldots \quad (4)$$

$$\therefore \frac{d^2\,c}{d\,x^2} = \frac{32000}{x^4} + {}'32 \quad \ldots \ldots \ldots \ldots \quad (5)$$

Substituting the value $x = 10$ in (5) $\frac{d^2 c}{d\,x^2}$ is positive.

$$\therefore x = 10 \text{ is a minimum.}$$

If now we substitute this value of x in (3) we get

$$c = 3200 + 1600 = 4800 \text{ shillings,}$$

Or the minimum cost is £240.

Reviews.

Measures, Weights, and Moneys. By W. S. B. Woolhouse, F.R.A.S., &c. Sixth Edition. Crosby, Lockwood & Co.

The great diversity existing between the weights, measures, and moneys of different countries, much as it is to be lamented, must be dealt with as an existing evil. To those of a sea-faring occupation the difficulties attending these diversities must be very sensibly felt, and to them this little volume should be of great service. In addition to general information about coinage, it gives an alphabetical arrangement of the relative weights, measures, and moneys of from 60 to 70 different countries, and thus seems as complete in that respect as could be desired. These very useful tables are supplemented by equally exhaustive information as to the different calendars termed the Hebrew, the Gregorian, and the Mahometan.

Civil Engineering. LAW & BURNELL, with additions by D. KINNEAR CLARK. Crosby, Lockwood & Co.

This interesting text book in its present form makes a valuable manual in the hand of any engineering student. It is a compilation of the original works of Law & Burnell, which have long been known as standard books of information to engineering students. As, however, engineering science and practice is constantly progressing, we are glad to find that the publishers have had the sense to place these old text books in the hands of such an able engineer as Mr. Kinnear Clark to be amended and brought up to the present practice. The information contained in it now comprises an introduction on elementary principles of construction, and in the second part gives very exhaustive details of the construction of roads and pavements, railways, tramways, canals and rivers, bridges and tunnels. The part, however, of more especial interest to our readers is contained in the second part, which deals with winds and waves, currents, sea defences, harbours, breakwaters, piers, and docks. A further part of this comprehensive little treatise is devoted to hydraulic engineering, and includes water supply, water works, aqueducts, drainage of land and towns, reclamations and irrigation of land. The reader who masters all these branches of the engineer's profession will be educated indeed.

Drawing for Marine Engineers. Written and Published by W. H. Thorn & Sons.

This little book is principally a collection of plates, 13 in number, comprising details of the marine engine, such as slide valve, piston, piston rod, connecting rod. crank shaft, steam tube, air pump details, valves, and cocks. The engraving of the plates is very good, and clear and excellent practice for marine draughting. The price of the book also is kept sufficiently low to be within the reach of all. The plates are accompanied by short descriptions.

The Yachting Record, Remembrancer and Advertiser. Proprietor, George Wilson, 157, Leadenhall Street.

This little pamphlet commences by exposing the quack almanacks which pretend to foretell weather 12 months in advance. A very neat design of a 3-ton racing cutter follows, also a list of flotsam and jetsam, concluding with a useful list of yachts and cutters for sale. This is a very valuable record to any desiring to purchase a good boat second-hand.

Recent Applications for Patents connected with Marine Engineering, Ship Construction, and Mechanical Appliances for use in Ships, from 21st January to 17th February, 1881.

299 J. Matthews. Rotary engines, reversing and steering gear, pumping, exhausting, compressing, and measuring fluids.
303 W. Franter. Machine guns.
321 W. R. Kinipple. Harbour and dock works.
322 C. Cullen. Ships or vessels.
343 E. G. Brewer (communicated by J. Alves). Fire bars and furnaces.
345 H. Schoening. Compasses.
349 J. Bettely. Construction of vessels and engines and propellers.
350 R. J. Smith. Antomatic speed regulator for marine engines and screw propellors.
363 W. Lord. Vertical steam boilers.
372 O. Wolff (communicated by A. Lelmann). Raising sunken ships, &c.
373 W. R. Lake (communicated by the Brunswick Berth Co. (Incorporated). Ships, sleeping berths.
416 G. Wilson. Low water alarm, and boiler safety valve.
444 F. Rigg. Valves.
449 R. Schram (communicated by E. Schenson). Valves.
455 F. Barr. Signal buoys.
493 F. W. Cady. Condensing apparatus (communicated by A. Mention).
510 H. H. Lake (communicated by D. Renshaw and H. P. Litchfield).
518 H. Bolten. Signal apparatus.
568 A. Murfet. Firebars specially adapted to marine boilers.
577 A. C. Kirk. Compound marine steam engines.
586 G. D. Davis. Hand or steam power steering gear.
698 E. Pilkington. Slide valves.
616 A. Henshaw. Piston rings.
622 F. R. Timby. Coast defences.
627 W. F. Goodwin. Steam engines, valve and piston, self oiling and valve operating mechanism.
635 W. Tulley. Securing tubes in boilers and condensers.
649 R. S. Werotte. Governors.
655 J. H. Johnson (communicated by N. B. Clark). Armoured vessels, fortifications, &c.
693 T. Nordenfelt. Submarine boats, &c.
697 P. Brotherhood. Rotating slide valves.

BOARD OF TRADE EXAMINATIONS.

Return of Engineers reported to have passed examination under the provisions of the Merchant Shipping Act, 1854, during the month. NOTE.—E 1 C denotes Extra First Class; 1 C, First Class; 2 C, Second Class.

January 29th, 1881.

Atkinson Francis	2 C	N Shlds.
Beveridge Thos. W.	1 C	Lvrpool.
Birkett William ...	1 C	London.
Brown Alexander	2 C	Lvrpool.
Brown Robert ...	1 C	Shmptn.
Burn Thomas T.	1 C	N Shlds.
Carr A. ...	2 C	do.
Duguid Jno. ...	1 C	London.
Dayer Huntley ...	1 C	Lvrpool.
Findlay William	1 C	Abrdeen
Gentles Richd. F.	2 C	Lvrpool.
Gill George ...	2 C	N Shlds.
Hind William B.	2 C	do.
Kettle Edward...	1 C	London.
King Jno. ...	2 C	Lvrpool.
King Alfred ...	2 C	N Shlds.
Oliver Jno. ...	2 C	Lvrpool.
Pattison Joseph	2 C	N Shlds.
Pitcher Wm. Hy.	2 C	Plymth.
Prydie Jno. ...	2 C	Lvrpool.
Schagerberg-Carl A. E.	1 C	N Shlds.
Sillars Mathew ...	2 C	Grnock.
Stansfield Robert	1 C	N Shlds.
Stewart Jno. ...	1 C	Belfast.
Sturrock David...	2 C	N Shlds.
Thomson Henry	1 C	Abrdeen
Williamson Thomas G.	2 C	Dundee.
Young Joseph ...	2 C	N Shlds.

February 5th, 1881.

Adams James ...	2 C	N Shlds.
Awburn Walter	2 C	do.
Aitken Robert...	1 C	Glasgow
Ambler Fredk....	2 C	Hull.
Blow John Henry	2 C	do.
Blackwood Robert H.	2 C	N Shlds.
Bowman David P.	1 C	Glasgow
Barringer Herbt.	2 C	London.
Brown William	1 C	Lvrpool
Cathcart William	2 C	do.
Charters Alex. ...	2 C	do.
Cameron Wm. T.	1 C	London.
Cochran John ...	2 C	Glasgow
Cooper Frank ...	2 C	do.
Cunningham Jsph.	1 C	do.
Cutchie Ambrose	1 C	Sndrlnd.
Cram George ...	2 C	N Shlds.
Cockeram Wm. Henry	2 C	Hull.
Davies David ...	1 C	Bristol
Duncan Daniel...	2 C	Glasgow
Gemmell Alex. ...	2 C	Leith.
Haylock Thomas	2 C	Sndrlnd.
Hollingsworth Wm.	2 C	Sndrlnd.
Horan William ...	2 C	Glasgow
Higgins John T.	2 C	do.
Hutchinson Robt. D.	2 C	Lvrpool.
Laidlaw George	2 C	Glasgow
Law Benjamin ...	2 C	Sndrlnd.
Maxwell John ...	1 C	Lvrpool.
McLeod James	1 C	Glasgow
Masson Robert ...	1 C	do.
Moon Thomas ...	2 C	Sndrlnd.
Maher Michael...	2 C	N Shlds.
Morton Geo. H...	2 C	do.
Nicolson Th. ...	2 C	Leith.
Neville S. ...	1 C	Sndrlnd.
Noble James ...	2 C	Glasgow
Phillips E. C. ...	2 C	London.
Prior Chas. M. ...	2 C	do.
Pounder James...	1 C	N Shlds.
Preece William...	1 C	Hull.
Runciman Alx....	1 C	Leith.
Ridley Wm. ...	2 C	N Shlds.
Robertson Chs ...	2 C	Glasgow
Stephenson Forster	1 C	Lvrpool.
Sutherland Thos.	1 C	Leith.
Taylor John ...	2 C	Sndrlnd.
Tait John ...	2 C	Glasgow
Truscott Frank...	1 C	London.

February 12th, 1881.

Backhouse Jsph.	2 C	Lvrpool.
Dibble John R ..	1 C	do.
Gibbs J. J. N. ...	2 C	London.
Lovett Michael ...	2 C	Lvrpool.
McDougal Wm. J.	2 C	do.
Petersen Ludwig	2 C	N Shlds.
Pawson Joseph...	2 C	do.
Ritchie John ..	2 C	London.
Robinson Robert	1 C	N Shlds.
Stewart W. G....	2 C	London.
Swales John ...	1 C	N Shlds.

February 19th, 1881.

Anderson Andw.	2 C	Lvrpool.
Allan Jno. ...	2 C	Grnock.
Allan Jno. ...	1 C	do.
Bayne Alexander	2 C	London.
Glen Andrew ...	2 C	Grnock.
Houston Campbl.	2 C	do.
Hanley Jno. Jas.	1 C	Lvrpool.
Kydd Alexander	2 C	Grnock.
Martin James ...	2 C	London.
Parry Thomas A.	2 C	do.
Stone John ...	2 C	do.
Thompson Chs. H.	2 C	do.
Warren Henry J.	2 C	do.

ROBERT JACKSON, Registrar-General.
General Register and Record Office of Shipping and Seamen,
32, Basinghall Street.

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